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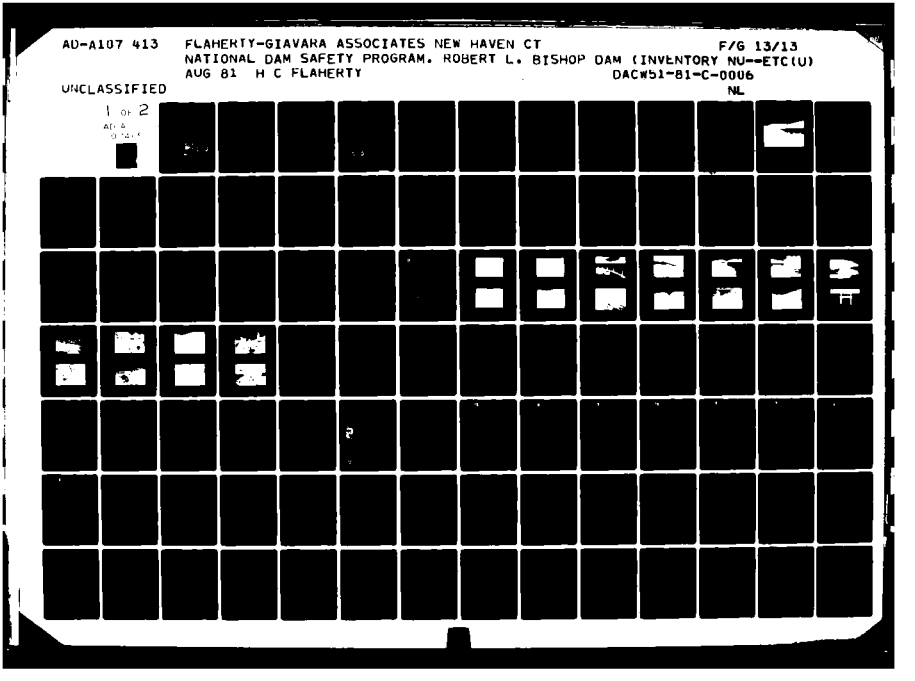

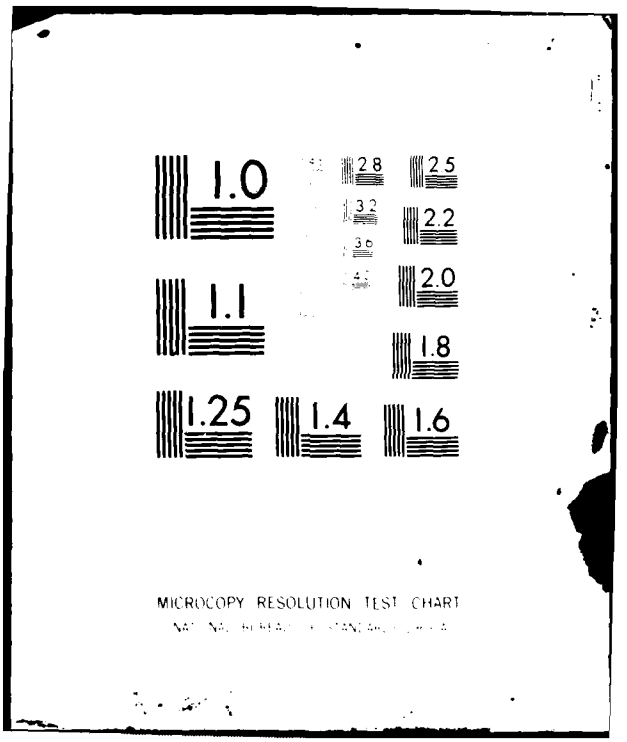
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DELAWARE RIVER BASIN

LEVEL II

ROBERT L. BISHOP DAM

DELAWARE COUNTY, NEW YORK
INVENTORY No. NY 534

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT, CORPS OF ENGINEERS
MAY 1981

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
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Robert L., Bishop Dam
Delaware County
Delaware River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Examination of available documents and visual inspections of the dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies that need to be evaluated and remedied.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped by the outflow resulting from all storms exceeding 18 percent of the Probable Maximum Flood (PMF). Dam overtopping, the resulting erosion of the embankment and hence, dam breaching would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

The classification "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to life downstream from the dam.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ROBERT L. BISHOP DAM
INVENTORY NO. NY 534
DELAWARE RIVER BASIN
DELAWARE COUNTY, NEW YORK

TABLE OF CONTENTS

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Robert L. Bishop Dam
State Located:	New York
County:	Delaware
Watershed:	Delaware River Basin
Stream:	Skunk Hollow Brook
Dates of Inspection:	March 12 and 14, 1981

ASSESSMENT

Examination of available documents and visual inspections of the dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies that need to be evaluated and remedied.

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped by the outflow resulting from all storms exceeding 18 percent of the Probable Maximum Flood (PMF). Dam overtopping, the resulting erosion of the embankment and hence, dam breaching would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

The classification "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to life downstream from the dam.

It is recommended that the following additional investigation be performed by a registered professional engineer engaged by the owner:

1. Conduct a detailed hydrologic and hydraulic analysis to determine the need for and methods of increasing the discharge capacity of the dam. This would include investigating the adequacy of the principal and emergency spillways and their respective discharge channels.

It is recommended that within 3 months of the final approval date of this report, the hydrologic investigation of the structure should be initiated and any resulting remedial measures should be completed within 18 months of the final approval.

The following remedial measures should be completed within 12 months to correct existing deficiencies:

1. Monitor the seepage and wet areas on the left side of the downstream slope and toe and in the emergency spillway channel bottom to determine if the observed conditions are seasonal or continuous. If the seepage at the embankment toe of slope is found to be continuous and is becoming more severe with time, determine the source of the seepage (i.e. through the foundation or embankment or between the embankment and abutment) and recommend corrective measures.

2. Provide riprap protection with an adequate filter zone in the gully at the downstream toe of slope between the outlet pipe and the seepage area to prevent or minimize the ongoing erosion into the slope from drainage of the wet area.

3. If the seepage conditions are found to occur continuously throughout the year, provide a means for collecting and draining water from the wet areas along the downstream toe of slope. Such methods may include stone drainage ditches or an additional toe drain system at a higher elevation with an appropriate filter to prevent the erosion of fines from the embankment. If a new drain is installed, it should be designed to discharge into the principal spillway outlet area to eliminate maintenance of the riprap required in Item 2. above.

4. Regrade the bottom and provide riprap protection in the relatively steep exit channel of the emergency spillway where it enters the principal spillway discharge channel.

5. Regrade the emergency spillway channel bottom to remove ruts and pockets and permit surface runoff without concentrated flow. After regrading, the area should be reseeded and mulched. Future traffic should be kept off this area.

6. Clear the brush and trees from the embankment slopes and the spillway channel. Remove and backfill all stumps less than 6 inches in diameter; however, cut all stumps 6 inches or more in diameter flush to the ground. Equipment and procedures for these operations should be such as to avoid damage to existing riprap, grass or weed cover on the slopes. All backfilled areas, or areas damaged by equipment or traffic should be reseeded and mulched.

7. Fill in the animal burrows on the embankment slopes.

8. Develop and implement a flood warning and emergency evacuation plan to alert downstream residents in the event conditions occur which could result in failure of the dam.

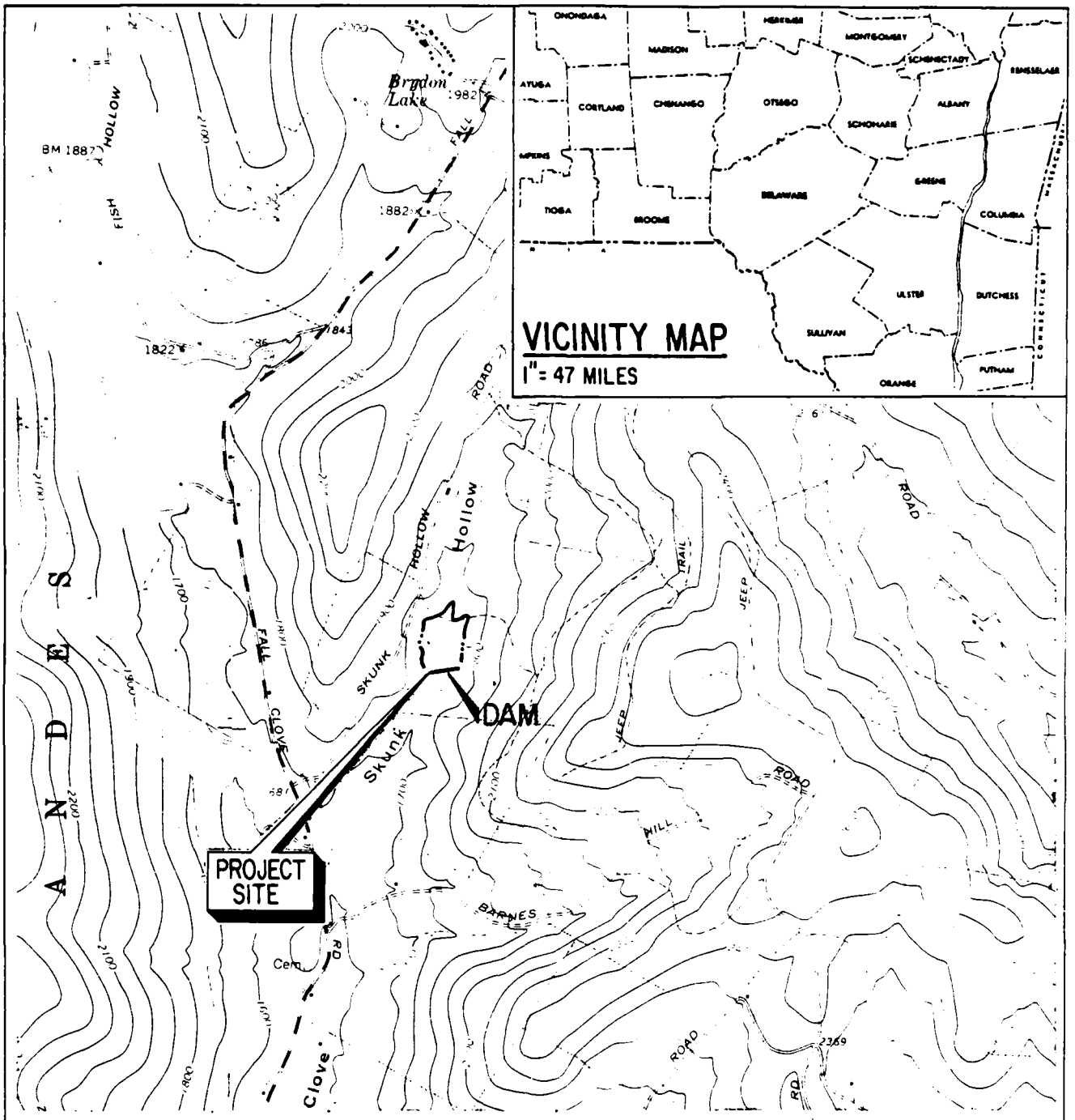
Submitted by: FLAHERTY GIAVARA ASSOCIATES, P.C.

Hugh C. Flaherty, P.E. & L.S.
Chairman of the Board
New York License No. 50508

Approved by:
Col. W. M. Smith, Jr.
New York District Engineer

Date: 3 Aug 81

PHOTO #1: Overview of
Robert L. Bishop Dam
Inventory No. NY 534



LOCATION MAP

ROBERT L. BISHOP DAM
INVENTORY No. NY 534

DELAWARE RIVER BASIN
DELAWARE COUNTY
ANDES, NEW YORK

FLAHERTY · GIAVARA ASSOCIATES, P.C.

NATIONAL DAM SAFETY PROGRAM
PHASE I INSPECTION REPORT
ROBERT L. BISHOP DAM
INVENTORY NO. NY 534
D.E.C. NO. 146B-3568
DELAWARE RIVER BASIN
DELAWARE COUNTY, NEW YORK

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367. Flaherty Giavara Associates, P.C. has been retained by the New York District to inspect and report on selected dams in the State of New York. Authorization and notice to proceed was issued to Flaherty Giavara Associates, P.C. under a letter of December 24, 1980 from W. M. Smith, Jr. Colonel, Corps of Engineers. Contract No. DACW 51-81-C-0006 has been assigned by the Corps of Engineers for this work.

b. Purpose

Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to life and property and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Robert L. Bishop Dam consists of an earthen embankment with a corrugated metal pipe principal spillway under the central portion of the embankment and a vegetated emergency spillway excavated into natural ground at the left abutment. Plans, profiles and sections prepared for the project by Baldwin-Kalmus Associates of Oneonta, New York are shown on drawings in Appendix F.

The dam embankment is approximately 410 feet long, 34 feet high and has an upstream slope of 3 horizontal to 1 vertical and a downstream slope of 2 to 1. The crest of the dam is 20 feet in width and its elevation is 115.0 (Assumed Datum). The embankment has a cross section consisting primarily of compacted glacial till and a 10 foot

wide cutoff of the same material extending 3 feet below the original ground surface. The downstream slope is provided with grass cover for erosion protection, whereas the upstream slope has a two foot thick layer of rockfill extending approximately thirty feet down the slope from the dam crest. Some loose riprap is in place around the principal spillway outlet. The embankment has internal drainage embedded in filter material near the downstream toe of the slope for its entire length. Two 6 inch diameter perforated bituminous-coated corrugated metal pipes join and then discharge adjacent to the principal spillway outlet.

The principal spillway is a drop inlet structure consisting of a 30 inch diameter corrugated metal pipe (CMP) riser and a 24 inch diameter corrugated metal pipe conduit with a stilling basin 150± feet downstream of the outlet.

The emergency spillway is a 250 foot long by 10± foot wide channel cut into earth at the left abutment (originally, the plans indicated the channel was to be 20 feet wide and excavated into the right abutment as shown on the drawings in Appendix F). It runs initially perpendicular to the embankment then curves gently to the right and intersects the discharge channel downstream of the principal spillway outlet. The right side of the spillway is formed by a 1 to 2 foot high earthen berm extending downstream from the left end of the dam crest. The left side slope is cut into natural earth at a slope of about 3 to 1. The channel side slope of the berm forming the right side of the spillway is about 6 to 1. The emergency spillway channel is about 3.0 feet below the embankment crest at the left end of the dam.

b. Location

The Robert L. Bishop Dam is located off Skunk Hollow Road approximately one half mile northeast of its intersection with Fall Clove Road in the Town of Andes, New York. The dam is located at latitude north 42°-10.1' and longitude west 74°-51.9' on the U.S. Geological Survey 7.5 minute series topographic map "Andes, New York". The Location Map on page i indicates where the dam is situated.

c. Size Classification

The maximum height of the dam is 34 feet and the maximum storage capacity is 154 acre-feet at the top of the dam. Therefore, the Robert L. Bishop Dam is classified as a "Small" dam as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

There are approximately 5 dwellings within the dam failure flood hazard area. Barnes Hill Road and Bussey Hollow Road are located downstream of the dam. Therefore, the dam is in the "High" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by Robert and Lucille Bishop. Their address and telephone number is as follows:

Owner

Contact: Robert and Lucille Bishop
120 Main Street
Delhi, New York 13753

Telephone: (607) 746-2624

f. Purpose

The primary purpose of this dam is to maintain the water level of the lake for recreational use.

g. Design and Construction History

The dam was designed by Baldwin-Kalmus Associates in 1966. It was constructed by I. and O. A. Slutzki, Contractors of Hunter, New York in 1967. No major post construction modifications have been made to the dam.

h. Normal Operating Procedure

The intake riser is always open; therefore, the water level is maintained at the elevation of the crest of the intake riser for normal flows. There are no regular operating procedures.

1.3 PERTINENT DATA

a. Drainage Area (Square Miles)	0.88
b. Discharge at Dam Site (CFS)	
- Top of Dam	365
- Crest of Emergency Spillway	36
- Crest of Riser	13
- Reservoir Drain Inlet	-

c. Elevations (Assumed Datum)

- Top of Dam	115.0
- Design High Water Level	113.5
- Crest of Emergency Spillway	112.0
- Crest of Riser	110.0
- Reservoir Drain Inlet	86.0

d. Reservoir Surface Area (Acres)

- Top of Dam	12.3
- Design High Water Level	11.8
- Crest of Emergency Spillway	11.1
- Crest of Riser	10.1

e. Storage (Acre-Feet)

- Top of Dam	154
- Design High Water Level	136
- Crest of Emergency Spillway	118
- Crest of Riser	97

f. Dam

- Type: Compacted glacial till with a glacial till cutoff	
- Length (Feet)	410
- Upstream Slope (H:V)	3:1
- Downstream Slope (H:V)	2:1
- Crest Width (Feet)	20

g. Emergency Spillway

- Type: Excavated earthen channel at left side of dam embankment	
- Length (Feet)	250
- Bottom Width (Feet)	10±
- Side Slopes (H:V)	
left	3:1
right	6:1
- Channel Bottom Slopes (Feet/Foot)	
upstream	0.333
downstream	0.083
- Control: None	

h. Principal Spillway

- Type: Drop inlet structure consisting of a 30 inch diameter corrugated metal pipe (CMP) riser and a 24 inch diameter corrugated metal pipe conduit (153

feet long) with a stilling basin 150± feet downstream from its outlet

- Control: None

i. Reservoir Drain

- Type: 24 inch diameter corrugated metal pipe (26 feet long)

- Control: 24 inch diameter slide gate located at the inlet to the principal spillway

j. Toe Drain

- Type: Two 6 inch diameter perforated bituminous-coated corrugated metal pipes in pervious fill

- Control: None

SECTION 2 - ENGINEERING DATA

2.1 GEOTECHNICAL DATA

a. Geology

The Robert L. Bishop Dam is located on a southerly flowing tributary to the Delaware River in the Catskill Mountain subprovince of the Allegheny Plateau physiographic province in New York State.

The topography in the area ranges from elevation 1740 at the tributary to about elevation 2200 to 2400 at the summits surrounding the reservoir.

The underlying bedrock is the Upper Walton Formation belonging to the Upper Devonian West Falls group. This formation is the terrestrial deposit of the Catskill Delta and consists of a medium to coarse-grained, red, silty sandstone and conglomerate containing minor amounts of red silty shale. It was derived from a combination of tributary channel, floodplain and beach deposits.

Above the bedrock, the valley bottom and side slopes are mantled by a heterogeneous mixture of clay, silt, sand and rock fragments. This soil is known as glacial till, and was deposited as the glacial ice melted back past the site some 13,000 to 14,000 years ago. Thin strata or beds of red clay occur overlying or within the glacial till. These beds probably developed in temporary lakes or ponds created during the retreat of the glaciers. Minor readvancements of the glaciers may have occurred in some areas, leading to additional deposition of glacial till over the clays at a later time.

b. Subsurface Investigations

Four test holes (apparently test pits) were excavated in the vicinity of the dam. The test pits encountered topsoil, sandy blue clay or sandy to silty gravel with clay in the upper 0.5 to 3.0 feet. Below 3 feet, the test holes, which terminated at depths of 9 feet without reaching bedrock, disclosed interbedded layers of red clay and apparent glacial till consisting of sandy clays to silty sands with stones. Sections of these test holes are shown on Sheet 7 of the drawings.

2.2 DESIGN RECORDS

This dam was designed by Baldwin-Kalmus Associates in 1966. As part of the design process, a design report and soils investigations were completed for the site. The soils data is included in Appendix F.

2.3 CONSTRUCTION RECORDS

This dam was constructed in 1967 by I. and O. A. Slutzki, Contractors of Hunter, New York. The contract drawings which were prepared by Baldwin-Kalmus Associates are included in Appendix F.

2.4 OPERATION RECORDS

There were no operation records available for this dam.

2.5 EVALUATION OF DATA

The data presented herein was obtained primarily from the files of the New York State Department of Environmental Conservation (DEC). This information appears to be reliable and adequate for the purposes of a Phase I Inspection Report.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspections of the Robert L. Bishop Dam were conducted on March 12 and 14, 1981. The weather was mostly sunny and the temperature was 40± F. At the time of these inspections, there were patches of snow on the ground and water was flowing in the principal spillway outlet pipe (See Photo No. 13).

b. Dam

The earthfill embankment of the dam is generally in fair condition. The crest of the dam is grass covered and is in fair condition (See Photo No. 3). There was no visible evidence of lateral movement, major seepage or erosion, significant settlement or other serious defects.

The following specific items were noted:

1. Wet ground apparently from seepage was noted at the toe of the downstream slope between the left abutment and the principal spillway outlet. Wet areas were also noted in the emergency spillway channel approximately adjacent to wet areas noted above (See Photos No. 16 and 17).

2. An erosion channel about 1 to 2 feet wide and several inches deep was noted to the left of the principal spillway outlet pipe at the toe of the downstream slope. This channel is being created by active flow from the wet area noted in Item 1 above.

3. Vehicle rutting was observed in the emergency spillway channel. Water from wet areas in the spillway channel near the downstream toe and left abutment was flowing along and through these ruts.

4. Erosion channels up to 1 to 2 foot wide and several inches to a foot deep were noted in the emergency spillway where it slopes into the main discharge channel. This area is displaced or undermined, leaving several areas unprotected (See Construction Photo No. 2 and Photos No. 18 and 19).

5. Both the riprapped upstream slope (above the reservoir level) and the grassed downstream slope have a minor cover of thick brush and small trees throughout (See Construction Photo No. 1 and Photos No. 4, 5, 6 and 7). Occasional small diameter animal burrows

were noted on the downstream slope.

6. The emergency spillway channel has localized areas of sparse brush and weed growth, as well as small pine trees which were planted on the side slopes (See Photos No. 8 and 9).

c. Principal Spillway

1. Drop Inlet Structure

The drop inlet is a 30 inch corrugated metal pipe (CMP) with an anti-vortex baffle plate. The drop inlet structure appeared to be in good condition at the time of the inspection; however, it has rusted somewhat (See Photo No. 10). The gate stem for the low level reservoir drain was observed but not operated during the inspection (See Photo No. 11).

2. Principal Spillway Conduit

The 24 inch diameter corrugated metal pipe (CMP) is in good condition where visible (See Photo No. 12). Some rust was noted on the inside of the pipe at the principal spillway outlet (See Photo No. 13).

3. Principal Spillway Outlet

The 24 inch diameter CMP conduit discharges into a stilling basin approximately 150 feet downstream of the principal spillway outlet. The stilling basin appeared to be stable and in fair condition (See Photo No. 15).

4. Principal Spillway Discharge Channel

The riprap-lined channel has an initial width of approximately 10 feet, and narrows slightly in the downstream direction. The side slopes are moderately steep, and typically 4 to 6 feet high. The banks are wooded and have no significant erosion (See Photo No. 14).

d. Emergency Spillway

The dam has a 10± foot wide earthen spillway excavated into the left end of the dam embankment, having approach and discharge channels with a heavy, unmowed (18± inches high) grass cover. The crest of the spillway at the centerline of the dam was bare earth with no grass protection. The crest of the dam and the crest of the emergency spillway are apparently used as accessways for "Jeep Trails" located in the eastern portion of the watershed

(See Photo No. 3).

The original construction plans indicate the emergency spillway was to be 20 feet wide and constructed on the right side of the dam; however, it was built 10± feet wide on the left side. These plans also indicate grouted riprap was to be placed on the embankment side of the emergency spillway. Although the riprap was placed, apparently it was not grouted which was documented in the State of New York, Department of Public Works' inspection report dated July 26, 1967 included in Appendix D (See Construction Photo No. 3).

The discharge channel is separated from the embankment by an earthen berm (See Construction Photo No. 4) which is in good condition. The discharge channel has not been mowed (See Photo No. 9) and erosion is occurring at the end of the channel where it discharges into the principal spillway discharge channel (See Photos No. 18 and 19).

e. Downstream Channel

The natural channel downstream of the dam site has a width of 10 to 20 feet. The streambed consists of a gravel material with gradations ranging from medium to coarse and currently appears stable.

f. Reservoir - Storage Pool Area

The reservoir area is bordered by moderately to steeply sloping woodlands (See Photo No. 2). There are no visible signs of instability or sedimentation problems in the reservoir area. There is no significant probability of landslides into the storage pool affecting the safety of the dam.

3.2 EVALUATION OF OBSERVATIONS

The visual inspections revealed several deficiencies. The following observations were made:

a. Apparent seepage was noted at the toe of the downstream slope and in the emergency spillway channel.

b. Erosion channels were observed to the immediate left of the principal spillway outlet pipe and at the exit to the emergency spillway.

c. Vehicle rutting was evident in the emergency spillway channel.

d. Both the upstream and downstream slopes had a minor cover of thick brush and small trees.

e. The emergency spillway channel had localized areas of sparse brush and weed growth, as well as landscaped pine trees.

f. Rust was observed at the entrance to the drop inlet and at the outlet of the principal spillway conduit.

g. The emergency spillway crest was lacking any type of erosion protection.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

The normal water surface level is maintained by the CMP riser of the drop inlet structure at elevation 110.0 (Assumed Datum). No operational procedures are in effect at this time.

4.2 MAINTENANCE OF DAM

It appears that the only maintenance procedures in effect include mowing of the dam embankment crest and emergency spillway bottom.

4.3 WARNING SYSTEM

No warning system is presently in effect.

4.4 EVALUATION

Presently, there are no operation or maintenance procedures in effect for this dam or its appurtenances. Therefore, regular operation and maintenance procdures should be implemented.

SECTION 5 - HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The dam is located in Andes on Skunk Hollow Brook, 5400+ feet upstream of Clove Hollow Brook. Four and a half miles further downstream, Clove Hollow Brook flows into Pepacton Reservoir (East Branch Delaware River) at a point which is approximately seven miles northeast of Downsville, New York.

The watershed (shown on the Watershed Map on Page C-5 in Appendix C) consists of 565 acres (0.88 square miles) of hilly uplands with typical slopes of 20 percent. Land within the watershed is largely undeveloped with extensive woodlands and scattered open fields. There are no significant waterbodies or wetlands upstream of the dam.

The watercourse upon which the dam is located is a small perennial stream with a typical flow width of 10 to 15 feet and a typical flow depth of 6 inches.

5.2 ANALYSIS CRITERIA

The purpose of the hydrologic/hydraulic analysis is to evaluate the spillway capacity and the potential for overtopping. The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corps of Engineers' *HEC-1 Computer* Model - Dam Safety Version. The procedure included determining the Probable Maximum Flood (PMF) runoff from the watershed and routing the inflow hydrograph through the impoundment to determine the outflow hydrograph. The unit hydrograph was defined by the Snyder Synthetic Unit Hydrograph method, and the Modified Puls routing procedure was incorporated.

The initial rainfall loss was assumed to be 1.0 inches, and the uniform rainfall loss was assumed to be 0.1 inches per hour. In accordance with recommended guidelines of the Corps of Engineers, the Probable Maximum Precipitation (PMP) was 20.1 inches (24 hour duration, 200 square mile area).

The analysis was conducted for both the full PMF and for several fractional PMF conditions. The PMF inflow of 2548 CFS was routed through the reservoir and the peak outflow was determined to be 2527 CFS.

5.3 SPILLWAY CAPACITY

The total outlet capacity is the sum of discharges from the principal spillway and the emergency spillway.

The principal spillway consists of a drop inlet and conduit. The drop inlet is a 30 inch diameter corrugated metal pipe

(CMP) that acts as a weir or an orifice depending on the elevation head at the inlet. The initial one foot of head on the structure produces a weir condition while stages from 111.5 feet to 113.5 feet produce an orifice condition. The final factor in analyzing this drop inlet structure is the flow conveyed in the 24 inch diameter CMP principal spillway conduit.

The emergency spillway is a 10± foot wide, trapezoidal-shaped vegetated channel. The original design information indicates the emergency spillway was designed to be used only by a flood event with an average return frequency of more than 50 years. However, since the emergency spillway that was actually constructed has a bottom width 10± feet less than the one designed, its frequency of use would be less than every 50 years.

The stage discharge curve for the combined principal and emergency spillways is as tabulated below:

Stage (Feet)	Discharge Capacity (CFS)	Element of Structure
110.0	0	Normal Water Level
110.5	8	--
111.0	25	--
111.5	31	--
112.0	36	Emergency Spillway Crest
112.5	51	--
113.0	82	--
113.5	129	Design High Water Level
114.0	192	--
115.0	365	Top of Dam

The total spillway capacity at the top of dam is 365 CFS.

The principal spillway can pass the peak outflow from a flood equal to approximately 5 percent of the PMF before use of the emergency spillway would be required.

The average flow velocity in the emergency spillway discharge channel would be 9.7 feet per second (FPS).

5.4 RESERVOIR CAPACITY

The storage capacity of the reservoir was obtained from design information and from supplementary calculations, as indicated below:

Stage (Feet)	Storage (Acre-Feet)	Storage (Inches of Runoff)
110.0	97	2.06
112.0	118	2.51
113.5	136	2.89
115.0	154	3.27

5.5 FLOODS OF RECORD

No data regarding flood records was obtained for the Robert L. Bishop Dam.

5.6 OVERTOPPING POTENTIAL

The results of the HEC-1 DB computer analysis indicate that the crest of the dam is overtopped by all storms exceeding 18 percent of the outflow from the the PMF event. The PMF discharge rate of 2537 cfs would occur at a peak flood stage of 116.4 feet, which is 1.4 feet above the crest of the dam.

The results of the analysis are tabulated below:

Flood Condition	Peak Inflow (CFS)	Peak Outflow (CFS)	Maximum Stage Elevation (Assumed Datum)
0.5 PMF	1274	1258	115.7
1.0 PMF	2548	2527	116.4

5.7 EVALUATION

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the combined capacity of the principal and emergency spillways is not adequate to pass either the full PMF or one half the PMF; only approximately 18 percent of the outflow from the PMF can be safely passed before overtopping will occur. The PMF event would overtop the dam for a duration of 8.5 hours and the maximum depth of flow over the crest would be 1.4 feet. It is estimated that as a result of overtopping, breaching of the dam would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadquate and the dam is assessed as unsafe, nonemergency.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

There was no visible evidence of major settlement, lateral movement or other signs of overall structural instability of the dam during the site examinations. Based on the conditions that were observed, there is no reason to question the static structural stability of the dam unless subsequent investigations recommended in Section 7.1c reveal the downstream toe seepage is coming through the embankment and is becoming progressively more severe with time.

b. Design and Construction Data

Baldwin-Kalmus Associates drawings for the "Dam and Lake for Robert L. Bishop" (see Appendix F) show a configuration for the embankment and emergency spillway that generally corresponds to the conditions observed on March 12 and 14, 1981, with the following exceptions:

1. The emergency spillway was constructed on the left side of the dam embankment instead of on the right side, as shown on these drawings.

2. No footbridge was constructed to the drop inlet and the reservoir drain.

Both of these exceptions were noted in the State of New York Department of Public Works' (DPW) Inspection Reports dated May 5 and July 26, 1967.

According to the drawings, the toe drain discharges into the riprap of the principal spillway outlet below the outlet pipe; however, construction photographs (No. 64-12 and 64-13 on page D-13 in Appendix D) taken on July 11, 1967 during one of the DPW inspections indicate the toe drain was actually installed 6± feet to the left of the outlet pipe. At the time of the site visits, the water level was several inches above the invert of the principal spillway; therefore, the outlet of the toe drain could not be observed.

There is no construction data to confirm the actual physical properties and configuration of earthfill in the embankments. However, the dam proportions are considered to be reasonable for the soils that were available at the site and the dam would be expected to have adequate safety margins with respect to stability under static loading conditions.

c. Seismic Stability

The Robert L. Bishop Dam is located in Seismic Zone 1, and in accordance with recommended Phase I guidelines does not require seismic analysis.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Condition

On the basis of the visual examinations, the Robert L. Bishop Dam is considered to be in fair condition. There were no signs of impending structural failure or other conditions which would warrant urgent remedial action, but a number of deficiencies were noted.

b. Adequacy of Information

The evaluation of this dam is based primarily on visual examinations, reference to the available Baldwin-Kalmus Associates' plans, approximate hydraulic and hydrologic computations, and application of engineering judgement. The visual examinations were somewhat hampered by patches of snow; however, the available information that was obtained is adequate for the purposes of a Phase I assessment.

c. Need for Additional Investigations

It is recommended the following additional investigation be performed for this dam by a registered professional engineer engaged by the owner:

1. Conduct a detailed hydrologic and hydraulic analysis to determine the need for and methods of increasing the discharge capacity of the dam. This would include investigating the adequacy of the principal and emergency spillways and their respective discharge channels.

d. Urgency

The additional investigation recommended in Section 7.1c should be initiated within 3 months and appropriate remedial measures completed within 18 months of the final approval date of this report. The recommended measures presented in Section 7.2 should be completed by the owner within 12 months of the final approval.

7.2 RECOMMENDED MEASURES

It is considered important that the following items be accomplished in addition to carrying out any remedial measures resulting from the investigation recommended in Section 7.1c:

a. Monitor the seepage and wet areas on the left side of the downstream slope and toe in the emergency spillway chan-

nel bottom to determine if the observed conditions are seasonal or continuous. If the seepage at the embankment toe is found to be continuous and is becoming more severe with time, determine the source of the seepage (i.e. through the foundation or embankment or between the embankment and abutment) to determine if corrective measures are required.

b. Provide riprap protection with an adequate filter zone in the gully at the downstream toe of slope between the outlet pipe and the seepage area to prevent or minimize the ongoing erosion into the slope from drainage of the wet area.

c. If the seepage conditions are found to occur continuously throughout the year, provide a means for collecting and draining water from the wet areas along the downstream toe of the slope. Such methods may include stone drainage ditches or an additional toe drain system at a higher elevation with an appropriate filter to prevent the erosion of fines from the embankment. If a new drain is installed, it should be designed to discharge into the principal spillway outlet area to eliminate maintenance of the riprap required in Item b. above.

d. Regrade the bottom and provide riprap protection in the relatively steep exit channel in the emergency spillway where it enters the principal spillway discharge channel.

e. Regrade the emergency spillway channel bottom to remove ruts and pockets and permit surface runoff without concentrated flow. After regrading, the area should be reseeded and mulched. Future traffic should be kept off this area.

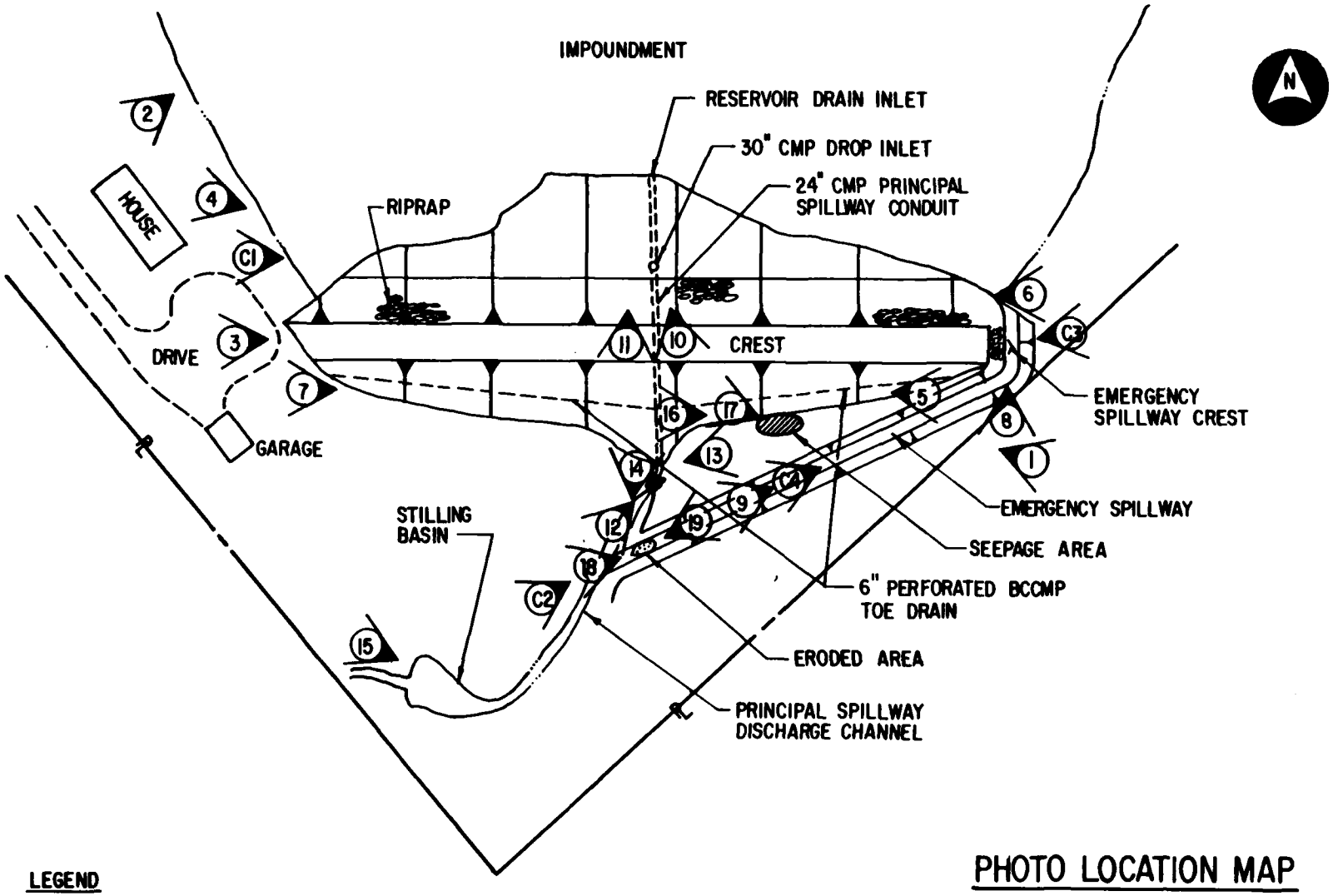
f. Clear the brush and trees from the embankment slopes and the spillway channel. Remove and backfill all stumps less than 6 inches in diameter; however, cut all stumps 6 inches or more in diameter flush to the ground. Equipment and procedures for these operations should be such as to avoid damage to existing riprap, grass or weed cover on slopes. All backfilled areas, or areas damaged by equipment or traffic should be reseeded and mulched.

g. Fill in the animal burrows on the embankment slopes.

h. Develop and implement a flood warning and emergency evacuation plan to alert downstream residents in the event conditions occur which could result in the failure of the dam.

APPENDIX A

PHOTOGRAPHS

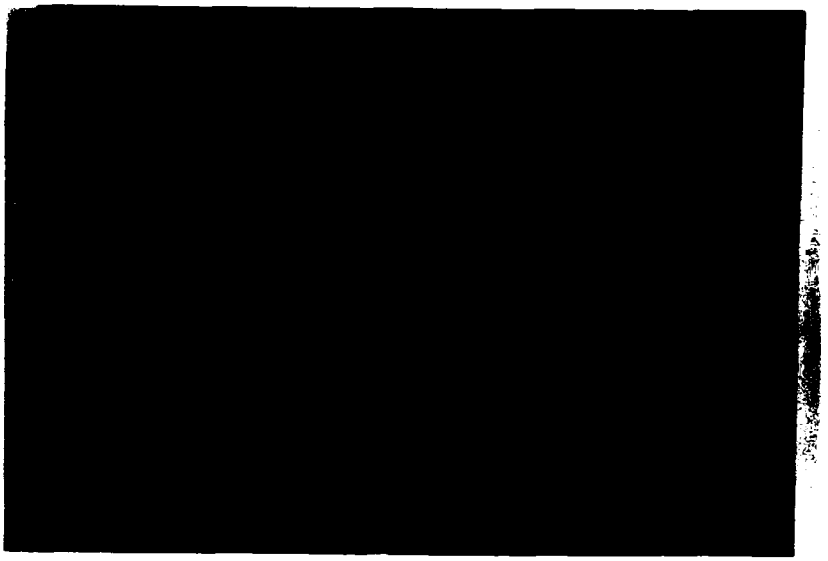


LEGEND

Number refers to caption. Arrow indicates direction of photograph. "C" refers to construction photograph.

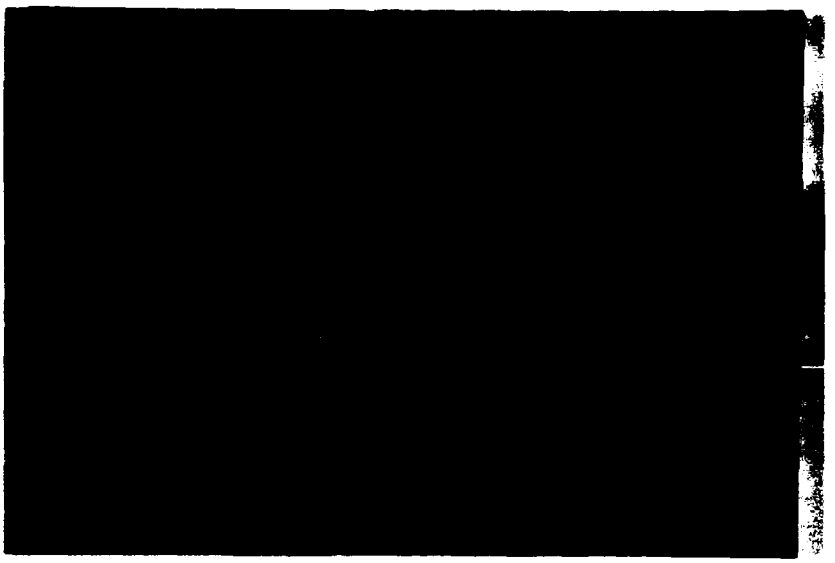
PHOTO LOCATION MAP

ROBERT L. BISHOP DAM
INVENTORY No. NY 534
DELAWARE COUNTY
ANDES, NEW YORK

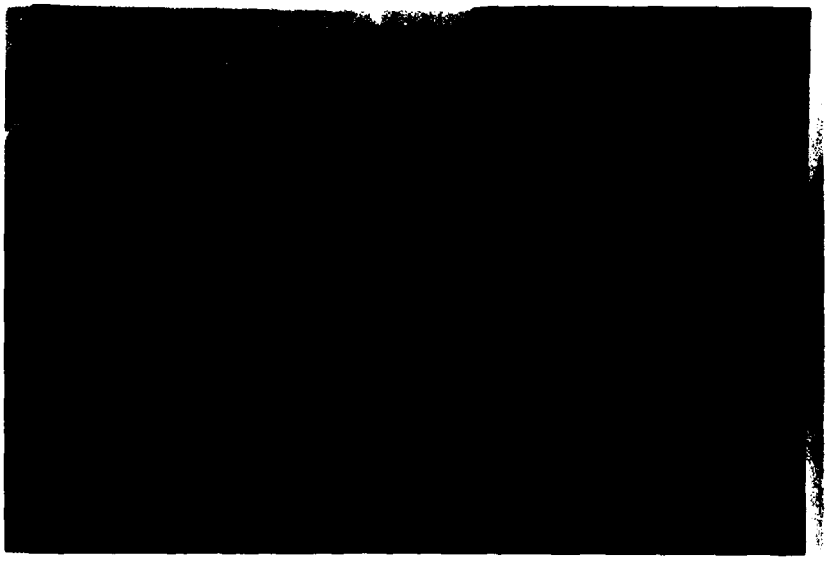


CONSTRUCTION PHOTO #1: Upstream face of dam (April 20, 1967)

CONSTRUCTION PHOTO #2: Emergency spillway outlet looking upstream; partial impoundment (April 20, 1967)



CONSTRUCTION PHOTO #3: Crest of dam and riprap at emergency spillway (July 11, 1967)



CONSTRUCTION PHOTO #4: Emergency spillway looking upstream; full impoundment (July 11, 1967)

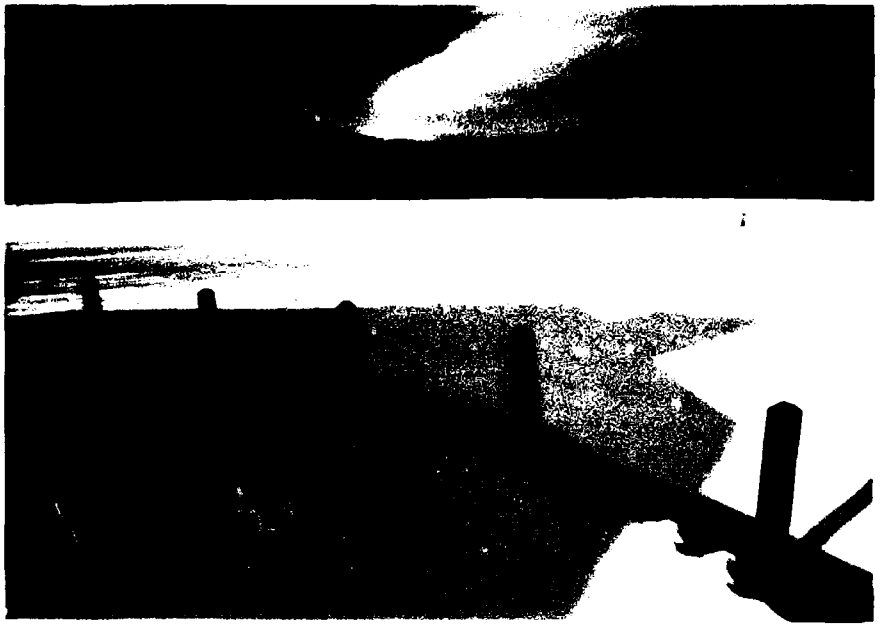


PHOTO #2: Overview of impoundment

PHOTO #3: Crest of dam looking toward left abutment

PHOTO #4: Overview of upstream face of dam

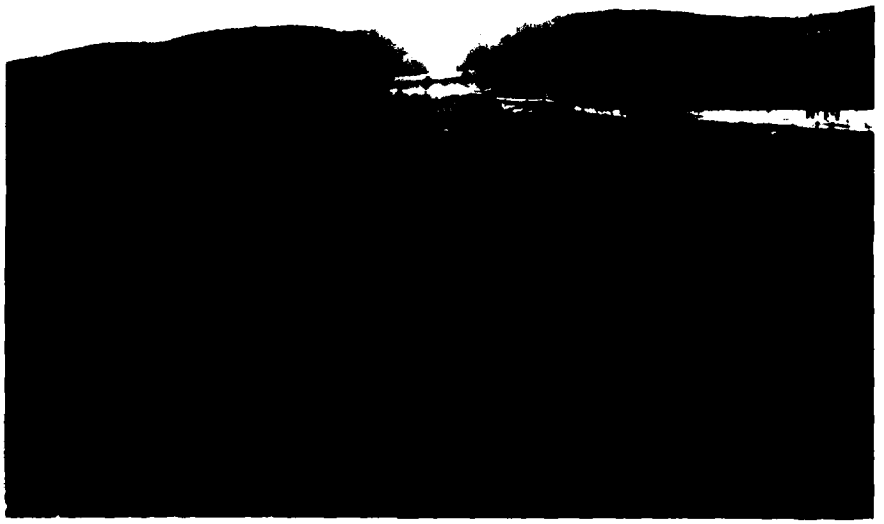


PHOTO #5: Overview of downstream face of dam

PHOTO #6: Upstream face of dam

PHOTO #7: Downstream face of dam

PHOTO #8: Emergency spillway looking toward impoundment

PHOTO #9: Emergency spillway looking upstream

PHOTO #10: Principal spillway drop inlet structure - 30" corrugated metal pipe (CMP) riser

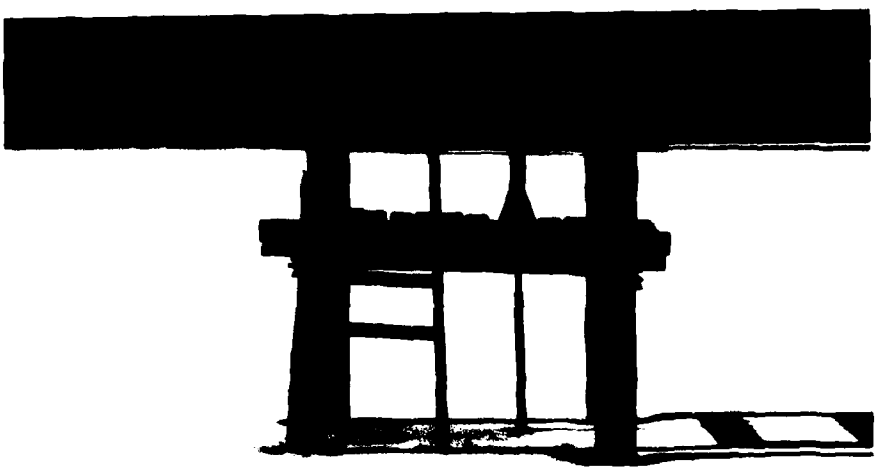


PHOTO #11: Impoundment drain operating gate

PHOTO #12: Principal spillway outlet pipe - 24" CMP

PHOTO #13: Riprap surrounding principal spillway outlet pipe

PHOTO #14: Downstream channel conditions

PHOTO #15: Stilling basin

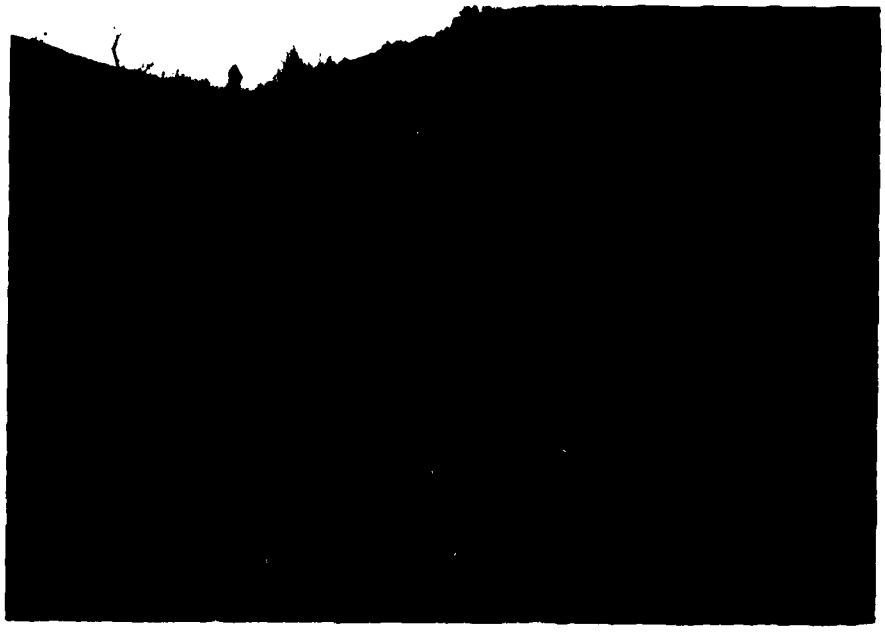


PHOTO #16: Seepage of downstream toe of slope

PHOTO #17: Closeup of seepage

PHOTO #18: Erosion at emergency spillway outlet (looking upstream)

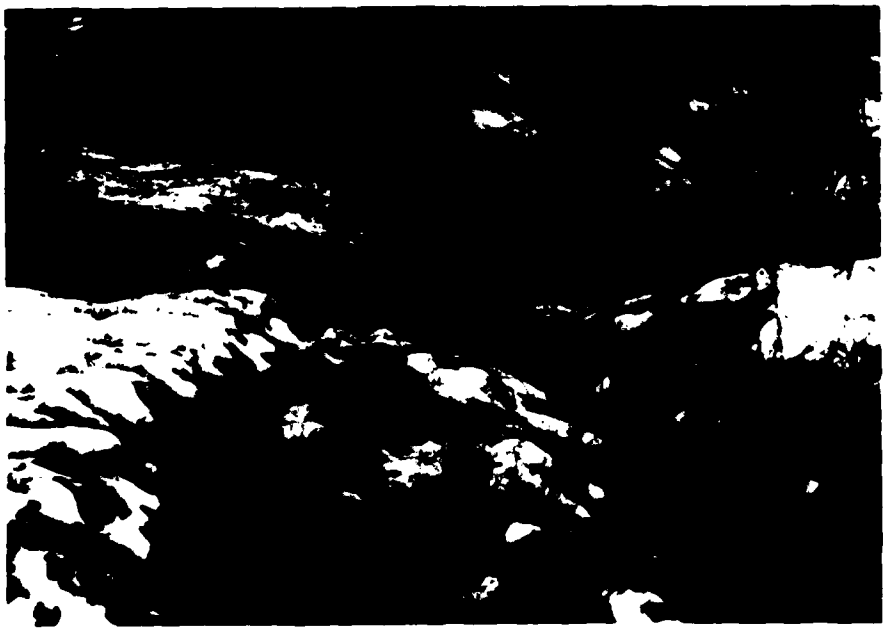


PHOTO #19: Erosion at emergency spillway outlet (looking downstream)

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Robert L. Bishop Dam

Fed. I.D. # NY 534 **DEC Dam No.** 146B-3568

River Basin Delaware

Location: Town Andes **County** Delaware

Stream Name Skunk Hollow Brook

Tributary of Clove Hollow Brook

Latitude (N) 42°-10.1' **Longitude (W)** 74°-51.9'

Type of Dam Earthen embankment

Hazard Category High

Date(s) of Inspection March 12 and 14, 1981

Weather Conditions Mostly sunny, 40°± F.

Reservoir Level at Time of Inspection Elevation 110.1 (Assumed Datum)

b. Inspection Personnel

R.C. Smith, T.L. Ward & R.A. Criscuolo of Flaherty Giavara Associates, P.C.; P.L. LeCount & J.J. Rixner of Haley & Aldrich, Inc.; E. Thomas of Salmon Associates

c. Persons Contacted (Including Address & Phone No.)

Robert L. Bishop

120 Main Street

Delhi, NY 13753

(607) 746-2624

d. History:

Date Constructed 1967 **Date(s) Reconstructed** Never

Designer Baldwin-Kalmus Associates

Constructed By I. and O.A. Slutzki, Contractors

Owner Robert and Lucille Bishop

2) **Embankment**

a. **Characteristics**

(1) **Embankment Material** Compacted glacial till

(2) **Cutoff Type** Compacted glacial till

(3) **Impervious Core** None

(4) **Internal Drainage System** Two 6 inch diameter perforated BCCMP toe drains join and then discharge to the left of the principal spillway outlet.

(5) **Miscellaneous** No comments

b. **Crest**

(1) **Vertical Alignment** Excellent; substantially level

(2) **Horizontal Alignment** Excellent; substantially straight

(3) **Surface Cracks** None evident

(4) **Miscellaneous** Mowed grass cover

c. **Upstream Slope**

(1) **Slope (Estimate - V:H)** 1:3

(2) **Undesirable Growth or Debris, Animal Burrows** Minor cover of thick brush and small trees

(3) **Sloughing, Subsidence or Depressions** None observed

(4) **Slope Protection** Sparse grass and weeds; some small trees; layer of riprap extending almost to the crest

(5) **Surface Cracks or Movement at Toe** None evident

d. **Downstream Slope**

(1) **Slope (Estimate - V:H)** 1:2

(2) **Undesirable Growth or Debris, Animal Burrows** Several small diameter (1 to 2 inch) holes observed

(3) **Sloughing, Subsidence or Depressions** None evident

(4) **Surface Cracks or Movement at Toe** None evident

(5) **Seepage** Seepage and wet area (very soft and muddy) noted at the downstream toe of slope between the left abutment and the principal spillway outlet. Seepage flows along the toe and forms an erosion gully as it empties into the principal spillway discharge channel adjacent to the outlet.

(6) **External Drainage System (Ditches, Trenches, Blanket)** None observed

(7) **Condition Around Outlet Structure** Some riprap surrounds the outlet of the principal spillway; an erosion gully has formed to the left of the outlet as described in (5) above.

(8) **Seepage Beyond Toe** None observed

e. **Abutments - Embankment Contact**

Right: good condition

Left: fair condition

(1) **Erosion at Contact** Erosion noted at the left abutment due to vehicle travel on the dam crest, spillway slopes and bottom and abutment slope.

(2) **Seepage Along Contact**

None observed

3) **Drainage System**

a. **Description of System** Drop inlet structure consisting of a 30 inch diameter corrugated metal pipe (CMP) riser and a 24 inch diameter CMP conduit, a riprap-lined discharge channel and a stilling basin.

b. **Condition of System** Good; however, rust was noted on the crest of the drop inlet riser and on the inside of the principal spillway conduit.

c. **Discharge from Drainage System** Riprap-lined discharge channel and stilling basin

4) **Instrumentation** (Monumentation/Surveys, Observation Wells, Weirs, Peizometers, Etc.)

None observed

5) **Reservoir**

a. **Slopes** Moderately to steeply sloping woodlands

b. **Sedimentation** No apparent problems

c. **Unusual Conditions Which Affect Dam** Low normal pool level

6) **Area Downstream of Dam**

a. **Downstream Hazard (No. of Homes, Highways, etc.)** Approximately 5 dwellings as well as Bussey Hollow Road and Barnes Hill Road are within the dam failure flood hazard area

b. **Seepage, Unusual Growth** None observed

c. **Evidence of Movement Beyond Toe of Dam** None observed

d. **Condition of Downstream Channel** Good; no aggradation or degradation

7) **Spillway(s) (Including Discharge Conveyance Channel)**

Principal spillway, emergency spillway and discharge conveyance channel

a. **General** Principal spillway and discharge conveyance channel handle normal flows, while the emergency spillway conveys flood events with average return frequencies greater than 50 years (from Baldwin-Kalmus Associates design data)

b. **Condition of Principal Spillway** Good; however, rust was noted as previously described in 3) b.

c. **Condition of Emergency Spillway** Fair; exposed soil in some areas of the approach channel, but it is essentially grass covered; there are small trees and brush on slopes, wheel ruts on channel bottom and 12 to 18 inch deep erosion gullies in the discharge channel as it exits into the discharge conveyance channel

d. **Condition of Discharge Conveyance Channel**
Good; the bed is riprap-lined and the banks appear stable.

8) **Reservoir Drain/Outlet**

Type: Pipe X Conduit ____ Other ____

Material: Concrete - Metal X Other -

Size: 24 inch corrugated metal pipe (CMP) **Length** 179 feet

Invert Elevations: **Entrance** 86.0 **Exit** 81.9

Physical Condition (Describe): **Unobservable** X

Material: Generally good; however, some rust has formed on the inside of the pipe outlet.

Joints: Unobservable **Alignment** Unobservable

Structural Integrity: Appears to be good

Hydraulic Capability: Good

Means of Control: **Gate** Slide Gate **Valve** ____ **Uncontrolled** ____

Operation: **Operable** ____ **Inoperable** ____ **Uncontrolled** ____

Present Condition (Describe): Good; however, the slide gate was not operated during the inspection.

9) **Structural**

a. **Concrete Surfaces** No concrete surfaces were observed

b. **Structural Cracking** Not applicable

c. **Movement - Horizontal & Vertical Alignment (Settlement)** Not applicable

d. **Junctions with Abutments or Embankments** Not applicable

e. **Drains - Foundation, Joint, Face** Not applicable

f. **Water Passages, Conduits, Sluices** Not applicable

g. **Seepage or Leakage** Not applicable

h. **Joints - Construction, etc.** Not applicable

i. **Foundation** Not Applicable

j. **Abutments** Not applicable

k. **Control Gates** 24 inch slide gate on the reservoir drain at its inlet

l. **Approach & Outlet Channels** Not applicable

m. **Energy Dissipators (Plunge Pool, etc.)** Stilling basin 150 feet downstream of the principal spillway outlet

n. **Intake Structures** Inaccessible

o. **Stability** Not applicable

p. **Miscellaneous** No comments

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition

None

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	115.0	12.3	154
2) Design High Water (Max. Design Pool)	113.5	11.8	136
3) Emergency Spillway Crest	112.0	11.1	118
4) Pool Level with Flashboards	--	--	--
5) Principal Spillway Crest	110.0	10.1	97

DISCHARGES:

	Volume (cfs)
1) Average Daily	Unknown
2) Emergency Spillway @ Maximum High Water (Top of Dam)	315
3) Emergency Spillway @ Design High Water	82
4) Principal Spillway @ Emergency Spillway Crest	36
5) Low Level Outlet @ Principal Spillway Crest	13
6) Total (of all facilities) @ Maximum High Water	365
7) Maximum Known Flood	Unknown
8) At Time of Inspection	5±

CREST: **ELEVATION:** 115.0

Type Vegetated earthen embankment

Width 20 feet **Length** 410 feet

Spillover Vegetated emergency spillway

Location Left abutment

SPILLWAY:

PRINCIPAL		EMERGENCY
110.0	**Elevation**	112.0
Drop inlet structure	**Type**	Earth excavated
30 inch CMP drop inlet and 24 inch CMP conduit	**Width**	10± feet
	Type of Control	
Weir	**Uncontrolled**	Weir
--	**Controlled**	--
--	**Type: (Flashboards; gate)**	--
One	**Number**	One
30 inch and 24 inch/179 feet	**Size/Length**	10± feet/250 feet
Corrugated metal	**Invert Material**	Vegetated cover on earth
Continuously	**Anticipated Length of Operating Service**	Unknown
Not applicable	**Chute Length**	250 feet
Not applicable	**Height Between Spillway Crest & Approach Channel Invert (Weir Flow)**	Not applicable

Type: _____

Location: _____

Records:

Date Unknown

Max. Reading Unknown

FLOOD WATER CONTROL SYSTEM:

Warning System None in effect

Method of Controlled Releases (mechanisms) Manually controlled slide gate to drain the impoundment

DRAINAGE AREA: 565 acres = 0.88 square miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type Rural, agriculture

Terrain - Relief Moderate to steep slopes

Surface - Soil Glacial till

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

Moderate to high due to rolling to steep uplands; glacial till soils; average watershed slope is 20 percent.

Potential Sedimentation problem areas (natural or man-made; present or future)

Potential surface erosion from agricultural fields

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

None

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the reservoir perimeter:

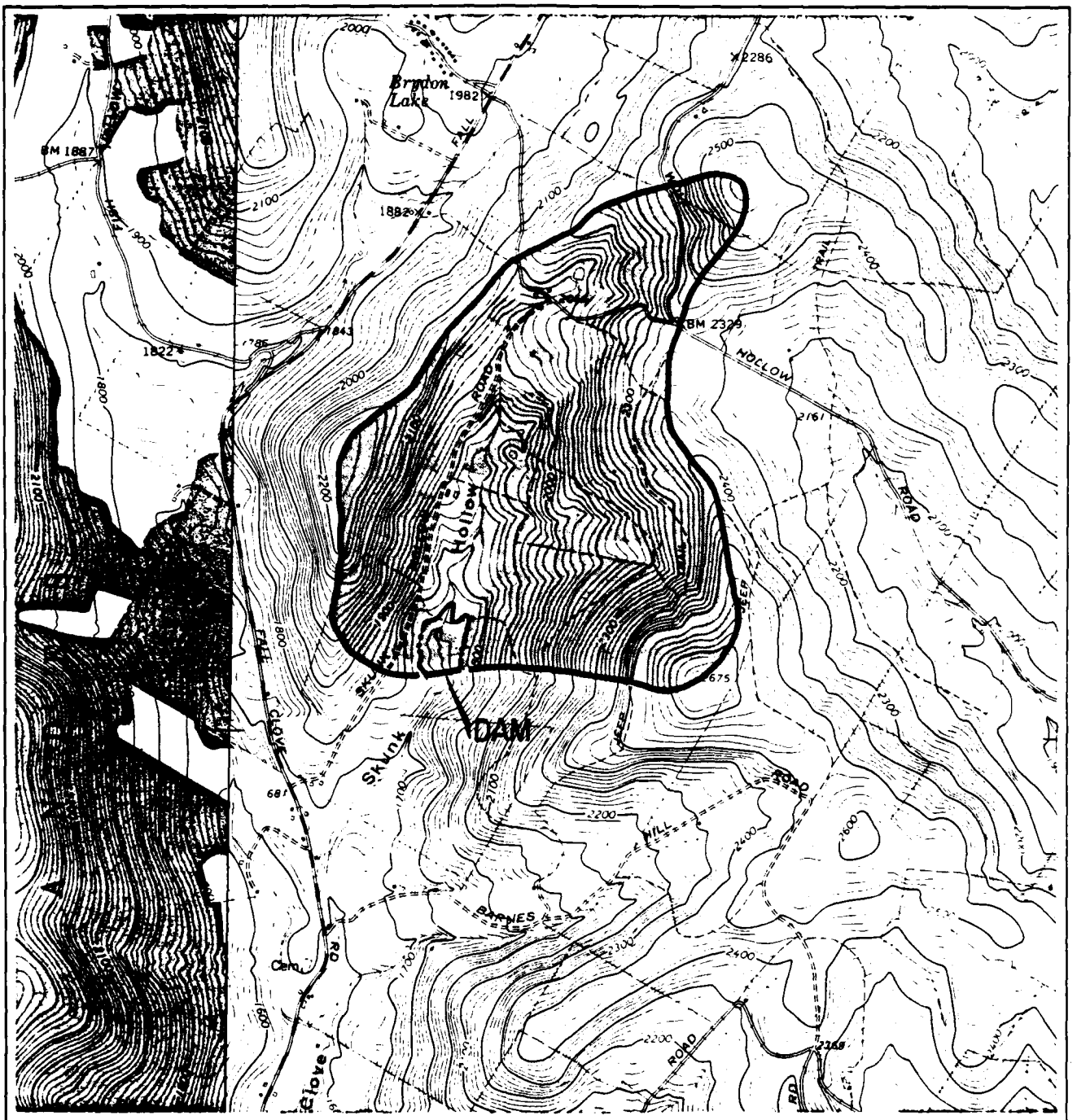
Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 1050± feet = 0.2 miles **(Miles)**

Length of Shoreline (@ Spillway Crest) 2700± feet = 0.5 miles **(Miles)**



WATERSHED MAP

ROBERT L. BISHOP DAM
INVENTORY No. NY 534

DELAWARE RIVER BASIN
DELAWARE COUNTY
ANDES, NEW YORK

FLAHERTY · GIAVARA ASSOCIATES, P.C.

CALCULATIONS

PROJECT Corps Dams NY 534

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1260

SHEET NO. 1 OF 8
BY RAC DATE 3-20-81
CHK'D. BY TLW DATE 4-28-81

WATERSHED DATA FOR HEC-1 SNYDER HYDROGRAPH

1) TIME TO PEAK

$L = 9000\ ft = 1.70$ miles
$L_c = 3500\ ft = 0.66$ miles
$C_t = 1.8$ basin has steep slopes

$$T_p = 1.8(1.70 \times 0.66)^{0.3} = 1.86 \text{ hours}$$

$$t_r = \frac{t_p}{5.5} = \frac{1.86}{5.5} = 0.34 \quad \text{USE } t_R = 0.5$$

$$t_{pR} = t_p + 0.25(t_R - t_r)$$
$$= 1.86 + 0.25(0.5 - 0.34)$$
$$= 1.90 \text{ HOURS}$$

2) SNYDER'S PEAKING COEFFICIENT (CP) = 0.63 for HIGHLANDS

3) % IMPERVIOUS

ROADS 2500' x 25'	=	62,500 ft²
HOUSES 5 x 1000	=	5,000 ft²
		67,500 ft²

$67{,}500\ ft^2 = 1.55$ acres

$\frac{1.55\ AC}{565\ AC} = 0.27\%$ of watershed
SAY 0.3%

4) WATERSHED AREA

$565 \text{ acres} / 640 = 0.88$ sq. miles.

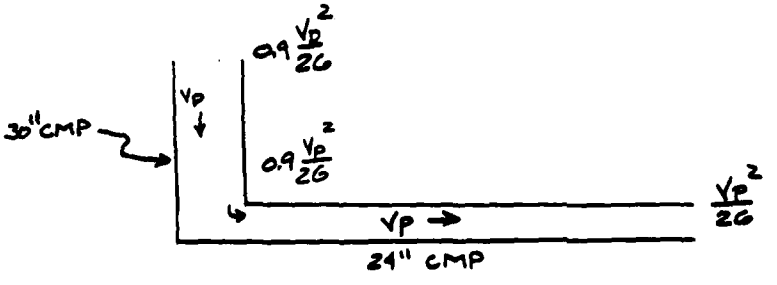
5) Rainfall Data (From Hydrometeorological Report No. 33)

24 Hour Duration PMP = 20.1 inches
For 200 square miles

Duration Hrs	Adj Factor %
6	111
12	122
24	133
48	143

Stage Discharge Data

Weir-Orifice-Pipe flows from principal spillway



Weir Flow controls from stages 110.0' to 111.0'

$Q = CLH^{1.5}$

Stage	Discharge
1100	0
110.5	8.5
111.0	25.0

PROJECT Corps Dams
- NY534
-

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1260

SHEET NO. 3 OF 8
BY RAC DATE 3-25-81
CHK'D. BY TLW DATE 4-28-81

ORFICE Flow Controls for Stages 111.5'-113.5'

$$Q = CA\sqrt{2G}\,(H^{1/2})$$

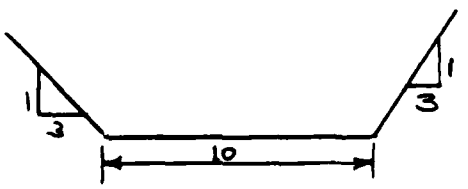
Stage	Discharge
111.5	30.5
112.0	35.5
112.5	39.5
113.0	43.0
113.5	46.5

PIPE Flow Controls for Stages > 114.0

$$\Sigma H = \left(0.9\frac{V_D^2}{64.4}\right) + \left(0.9\frac{V_P^2}{64.4}\right) + L_P S_F + \frac{V_P^2}{64.4}$$

Stage	Discharge
114.0	50.0
115.0	50.0
117.21	51.0

Flow From Emergency Spillway starts at Stages > 112.0



$$Q = \frac{1.49}{n} R_h^{2/3} S^{1/2} A$$

$n = 0.03$
$S = 0.5\%$

Stage	Discharge
112.0	0
112.5	11.7
113.0	39.3
113.5	82.4
114.0	142.0
115.0	314.6
117.21	996.8

Discharge over top of dam starts @ 115.0

$Q = CLH^{1.5}$

$= 2.5(120)(2.21)^{1.5} = 3449.7$ CFS

Cumulative Stage Discharge Data

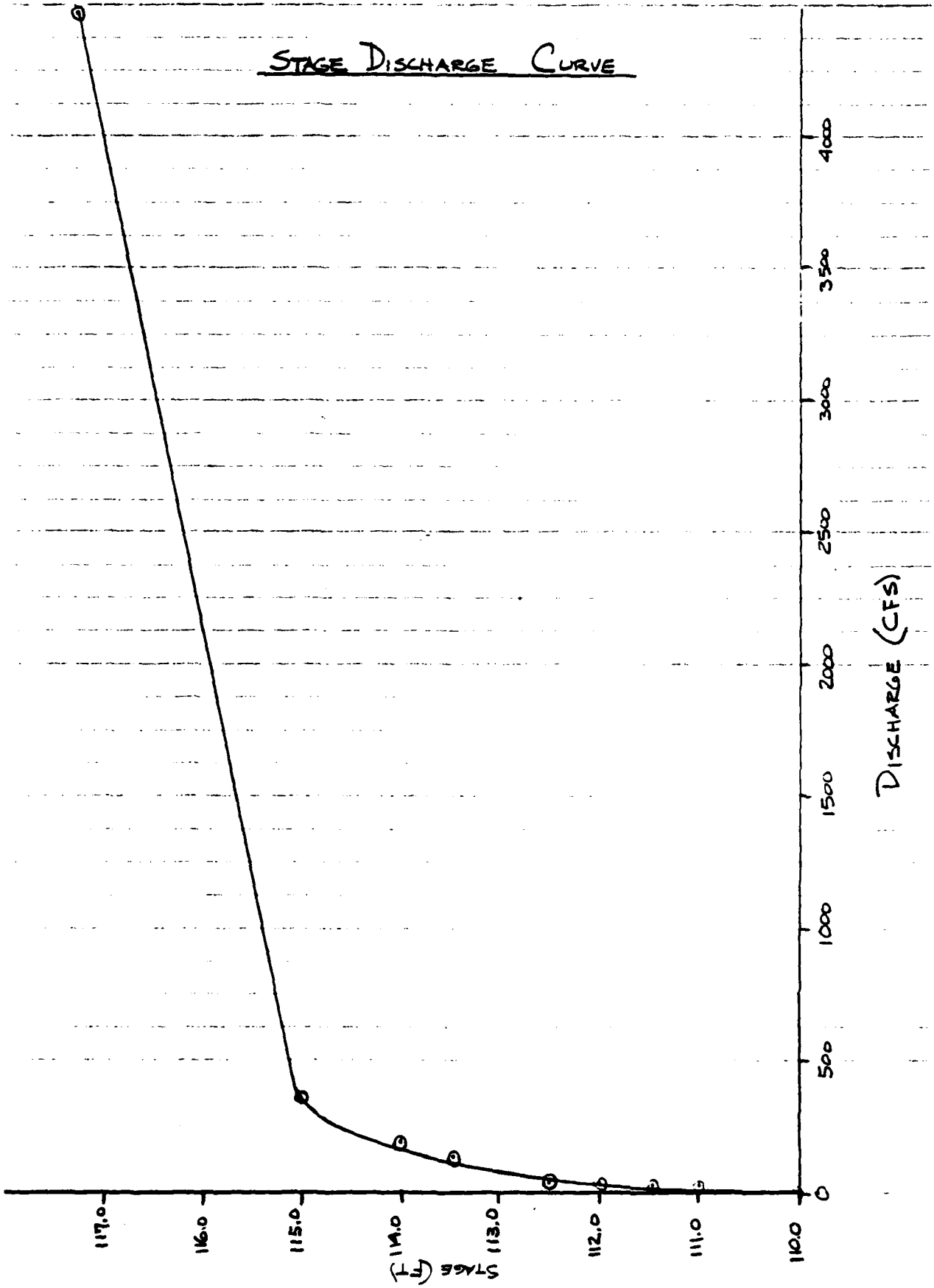
Stage (ft)	Discharge (CFS)	
110.0	0	
110.5	8.5	
111.0	25.0	
111.5	30.5	
112.0	35.5	
112.5	51.2	
113.0	82.3	
113.5	128.9	
114.0	192.0	
115.0	364.6	
117.21	1047.8	(4497.5 w/ Top of Dam)

PROJECT NY 534

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1260

SHEET NO. 5 OF 8
BY RAC DATE 4-23-81
CHK'D. BY TLW DATE 4-28-81

STAGE DISCHARGE CURVE



FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1260

EMERGENCY SPILLWAY DISCHARGE CHANNEL

$b = 10$

$Z = 3:1$

$S = 0.5\%$ @ Dam Section

$N = 0.03$

$Q = 2787$ (PMF - Principal Spillway Discharge)

FIND D, A, V

$$Q = \frac{K'}{N} b^{8/3} S^{1/2}$$ (KING'S HANDBOOK Table 7-11)

$$K' = \frac{(2787)(0.03)}{(10)^{2.67}(0.005)^{1/2}} = 2.55$$

$$\frac{.83 - .82}{2.58 - 2.51} = \frac{x}{2.55 - 2.51} \qquad x = 0.0057$$

$$\frac{D}{b} = 0.82 + 0.0057 = 0.8257$$

$$D = 0.8257 \times 10 = 8.26'$$

$$A = (10 \times 8.26) + (8.26 \times 3 \times 8.26) = 287.3 \text{ ft}^2$$

$$V = \frac{Q}{A} = \frac{2787}{287.3} = 9.70 \text{ ft/sec}$$

CHECK CRITICAL DEPTH

$$K_c' = \frac{Q}{b^{5/2}} = \frac{2787}{10^{5/2}} = 8.81 \quad \text{(KING'S HANDBOOK TABLE 8-5)}$$

$$\frac{8.94 - 8.69}{.74 - .73} = \frac{8.81 - 8.69}{x} \qquad x = 0.0048$$

$$\frac{D_c}{b} = 0.0048 + 0.73 = 0.7348$$

$$D_c = 10 \times 0.7348 = 7.35'$$

$D_c < D_N$ ∴ Subcritical flow occurs @ DAM SECTION

EMERGENCY SPILLWAY @ Discharge to PLUNGE POOL

$b = 10$
$Z = 3:1$
$S = 8.3\%$
$N = 0.03$
$Q = 2787$ (PMF - PRINCIPAL SPILLWAY DISCHARGE)

FIND D, A, V

$$Q = \frac{K'}{N} b^{8/3} S^{1/2} \quad \text{(KINGS HANDBOOK TABLE 7-11)}$$

$$K = \frac{(2787)(0.03)}{(10)^{2.67}(0.083)^{1/2}} = 0.6252$$

$$\frac{0.633 - 0.603}{.44 - .43} = \frac{.6252 - .603}{x} \qquad x = 0.0074$$

$$\frac{D}{b} = 0.0074 + 043 = 0.4374$$

$D = 0.4374 \times 10 = 4.37'$

$A = (10 \times 4.37) + (4.37 \times 3 \times 4.37) = 101.0$

$V = \frac{Q}{A} = \frac{2787}{101} = 27.6$ ft/sec ∴ Erosion will occur @ Emergency Spillway Exit

$D_c = 7.35'$

@ End $D_c > D_N$ ∴ supercritical flow exists.

HEC-1 FLOOD HYDROGRAPH COMPUTATIONS

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FLAHERTY GIAVARA ASSOCIATES, P.C.
 ********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 ********************************
     1                 A1 NATIONAL DAM INSPECTION PROGRAM, PHASE I REPORT, CORPS OF ENGINEERS - NEW YORK DISTRICT
     2                 A2 DAM INVENTORY NO. NY 534, ROBERT L. BISHOP DAM, DELAWARE COUNTY, NEW YORK, JUNE 26, 1981
     3                 A3 PREPARED BY FLAHERTY GIAVARA ASSOCIATES, P.C., ONE COLUMBUS PLAZA, NEW HAVEN, CONNECTICUT
     4                 B    120         0        30         0         0         0         0         2         0         0
     5                 B1     5
     6                 J      1         9         1
     7                 J1   0.1       0.2       0.3       0.4       0.5       0.6       0.7       0.8       1.0
     8                 K      0         1                             0         0         1         0
     9                 K1 INFLOW HYDROGRAPH, SNYDER METHOD
    10                 M      1         1      0.88                   0       1.0                             1
    11                 P      0        20         1       111       122       133       143
    12                 T                                                                 1       0.1                 0.003
    13                 W   1.90      0.63
    14                 X   -2.0     -0.10       1.5
    15                 K      1         1                             0         1         1         0
    16                 K1  RESERVOIR ROUTING  MODIFIED PLUS METHOD
    17                 Y                                       1         1
    18                 Y1     3                                                           0        -1
    19                 Y4 110.0     110.5     111.0     111.5     112.0     112.5     113.0     113.5     114.0     115.0
    20                 Y4 116.5    117.21
    21                 Y5     0       8.5      25.0      30.5      35.5      51.2      82.3     128.9     192.0     364.6
    22                 Y5 779.0    1047.8
    23                 $A  10.1      11.1      12.0      12.7      13.4      14.1
    24                 $E 110.0     112.0     114.0     116.0     118.0     120.0
    25                 $$ 112.0
    26                 $D 115.0       2.5       1.5     420.0
    27                 K     99
1                                PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
                                        RUNOFF HYDROGRAPH AT            1
                                        ROUTE HYDROGRAPH TO             1
                                        END OF NETWORK

 ********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 ********************************

 RUN  DATE: 6/26/
      TIME: 12:25 PM

                    NATIONAL DAM INSPECTION PROGRAM, PHASE I REPORT, CORPS OF ENGINEERS - NEW YORK DISTRICT
                    DAM INVENTORY NO. NY 534, ROBERT L. BISHOP DAM, DELAWARE COUNTY, NEW YORK, JUNE 26, 1981
                    PREPARED BY FLAHERTY GIAVARA ASSOCIATES, P.C., ONE COLUMBUS PLAZA, NEW HAVEN, CONNECTICUT

                                                JOB SPECIFICATION
                     NQ      NHR      NMIN      IDAY      IHR      IMIN     METRC      IPLT      IPRT     NSTAN
                    120        0        30         0        0         0         0         2         0         0
                                              JOPER       NWT     LROPT     TRACE
                                                  5         0         0         0
```

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH, SNYDER METHOD

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	0.88	0.00	0.88	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.10	111.00	122.00	133.00	143.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.90 CP=0.63 NTA= 0

RECESSION DATA
STRTQ= -2.00 QRCSN= -0.10 RTIOR= 1.50

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 4.35 AND R= 3.38 INTERVALS

UNIT HYDROGRAPH 21 END-OF-PERIOD ORDINATES, LAG= 1.88 HOURS, CP= 0.63 VOL= 1.00

23. 81. 148. 187. 175. 134. 100. 74. 55. 41.
30 23. 17. 12. 9. 7. 5. 4 3 2.
2.

0

END-OF-PERIOD FLOW

MO DA	HR MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO DA	HR MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.30	1	0.01	0.00	0.01	2.	1.02	6.30	61	0.18	0.13	0.05	29.
1.01	1.00	2	0.01	0.00	0.01	2.	1.02	7.00	62	0.18	0.13	0.05	38.
1.01	1.30	3	0.01	0.00	0.01	2.	1.02	7.30	63	0.18	0.13	0.05	54.
1.01	2.00	4	0.01	0.00	0.01	2.	1.02	8.00	64	0.18	0.13	0.05	75.
1.01	2.30	5	0.01	0.00	0.01	1.	1.02	8.30	65	0.18	0.13	0.05	95.
1.01	3.00	6	0.01	0.00	0.01	1.	1.02	9.00	66	0.18	0.13	0.05	110.
1.01	3.30	7	0.01	0.00	0.01	1.	1.02	9.30	67	0.18	0.13	0.05	121.
1.01	4.00	8	0.01	0.00	0.01	1.	1.02	10.00	68	0.18	0.13	0.05	129.
1.01	4.30	9	0.01	0.00	0.01	1.	1.02	10.30	69	0.18	0.13	0.05	135.
1.01	5.00	10	0.01	0.00	0.01	1.	1.02	11.00	70	0.18	0.13	0.05	140.
1.01	5.30	11	0.01	0.00	0.01	1.	1.02	11.30	71	0.18	0.13	0.05	143.
1.01	6.00	12	0.01	0.00	0.01	1.	1.02	12.00	72	0.18	0.13	0.05	145.
1.01	6.30	13	0.01	0.00	0.01	1.	1.02	12.30	73	1.12	1.07	0.05	168.
1.01	7.00	14	0.01	0.00	0.01	1.	1.02	13.00	74	1.12	1.07	0.05	245.
1.01	7.30	15	0.01	0.00	0.01	1.	1.02	13.30	75	1.34	1.29	0.05	389.
1.01	8.00	16	0.01	0.00	0.01	1.	1.02	14.00	76	1.34	1.29	0.05	582.
1.01	8.30	17	0.01	0.00	0.01	1.	1.02	14.30	77	1.67	1.62	0.05	786.

1.01	9.00	18	0.01	0.00	0.01	1.	1.02	15.00	78	1.67	1.62	0.05	980.
1.01	9.30	19	0.01	0.00	0.01	1.	1.02	15.30	79	2.03	1.98	0.05	1170.
1.01	10.00	20	0.01	0.00	0.01	1.	1.02	16.00	80	6.44	6.39	0.05	1461.
1.01	10.30	21	0.01	0.00	0.01	1.	1.02	16.30	81	1.56	1.51	0.05	1894.
1.01	11.00	22	0.01	0.00	0.01	1.	1.02	17.00	82	1.56	1.51	0.05	2316.
1.01	11.30	23	0.01	0.00	0.01	1.	1.02	17.30	83	1.23	1.18	0.05	2548.
1.01	12.00	24	0.01	0.00	0.01	1.	1.02	18.00	84	1.23	1.18	0.05	2482.
1.01	12.30	25	0.08	0.00	0.08	1.	1.02	18.30	85	0.11	0.06	0.05	2224.
1.01	13.00	26	0.08	0.00	0.08	1.	1.02	19.00	86	0.11	0.06	0.05	1912.
1.01	13.30	27	0.10	0.00	0.10	1.	1.02	19.30	87	0.11	0.06	0.05	1570.
1.01	14.00	28	0.10	0.00	0.10	1.	1.02	20.00	88	0.11	0.06	0.05	1229.
1.01	14.30	29	0.13	0.00	0.13	1.	1.02	20.30	89	0.11	0.06	0.05	935.
1.01	15.00	30	0.13	0.00	0.13	1.	1.02	21.00	90	0.11	0.06	0.05	712.
1.01	15.30	31	0.15	0.00	0.15	1.	1.02	21.30	91	0.11	0.06	0.05	546.
1.01	16.00	32	0.48	0.43	0.05	11.	1.02	22.00	92	0.11	0.06	0.05	423.
1.01	16.30	33	0.12	0.07	0.05	38.	1.02	22.30	93	0.11	0.06	0.05	332.
1.01	17.00	34	0.12	0.07	0.05	73.	1.02	23.00	94	0.11	0.06	0.05	263.
1.01	17.30	35	0.09	0.04	0.05	99.	1.02	23.30	95	0.11	0.06	0.05	246.
1.01	18.00	36	0.09	0.04	0.05	104.	1.03	0.00	96	0.11	0.06	0.05	236.
1.01	18.30	37	0.01	0.00	0.01	94.	1.03	0.30	97	0.00	0.00	0.00	227.
1.01	19.00	38	0.01	0.00	0.01	79.	1.03	1.00	98	0.00	0.00	0.00	218.
1.01	19.30	39	0.01	0.00	0.01	64.	1.03	1.30	99	0.00	0.00	0.00	209.
1.01	20.00	40	0.01	0.00	0.01	49.	1.03	2.00	100	0.00	0.00	0.00	201.
1.01	20.30	41	0.01	0.00	0.01	37.	1.03	2.30	101	0.00	0.00	0.00	193.
1.01	21.00	42	0.01	0.00	0.01	28.	1.03	3.00	102	0.00	0.00	0.00	185.
1.01	21.30	43	0.01	0.00	0.01	21.	1.03	3.30	103	0.00	0.00	0.00	178.
1.01	22.00	44	0.01	0.00	0.01	15.	1.03	4.00	104	0.00	0.00	0.00	171.
1.01	22.30	45	0.01	0.00	0.01	11.	1.03	4.30	105	0.00	0.00	0.00	164.
1.01	23.00	46	0.01	0.00	0.01	10.	1.03	5.00	106	0.00	0.00	0.00	158.
1.01	23.30	47	0.01	0.00	0.01	10.	1.03	5.30	107	0.00	0.00	0.00	151.
1.02	0.00	48	0.01	0.00	0.01	9.	1.03	6.00	108	0.00	0.00	0.00	145.
1.02	0.30	49	0.07	0.02	0.05	9.	1.03	6.30	109	0.00	0.00	0.00	140.
1.02	1.00	50	0.07	0.02	0.05	9.	1.03	7.00	110	0.00	0.00	0.00	134.
1.02	1.30	51	0.07	0.02	0.05	8.	1.03	7.30	111	0.00	0.00	0.00	129.
1.02	2.00	52	0.07	0.02	0.05	12.	1.03	8.00	112	0.00	0.00	0.00	124.
1.02	2.30	53	0.07	0.02	0.05	15.	1.03	8.30	113	0.00	0.00	0.00	119.
1.02	3.00	54	0.07	0.02	0.05	18.	1.03	9.00	114	0.00	0.00	0.00	114.
1.02	3.30	55	0.07	0.02	0.05	21.	1.03	9.30	115	0.00	0.00	0.00	109.
1.02	4.00	56	0.07	0.02	0.05	22.	1.03	10.00	116	0.00	0.00	0.00	105.
1.02	4.30	57	0.07	0.02	0.05	23.	1.03	10.30	117	0.00	0.00	0.00	101.
1.02	5.00	58	0.07	0.02	0.05	24.	1.03	11.00	118	0.00	0.00	0.00	97.
1.02	5.30	59	0.07	0.02	0.05	25.	1.03	11.30	119	0.00	0.00	0.00	93.
1.02	6.00	60	0.07	0.02	0.05	26.	1.03	12.00	120	0.00	0.00	0.00	89.
									SUM	28.74	25.00	3.74	31416.
										(730.)	(635.)	(95.)	(889.60)

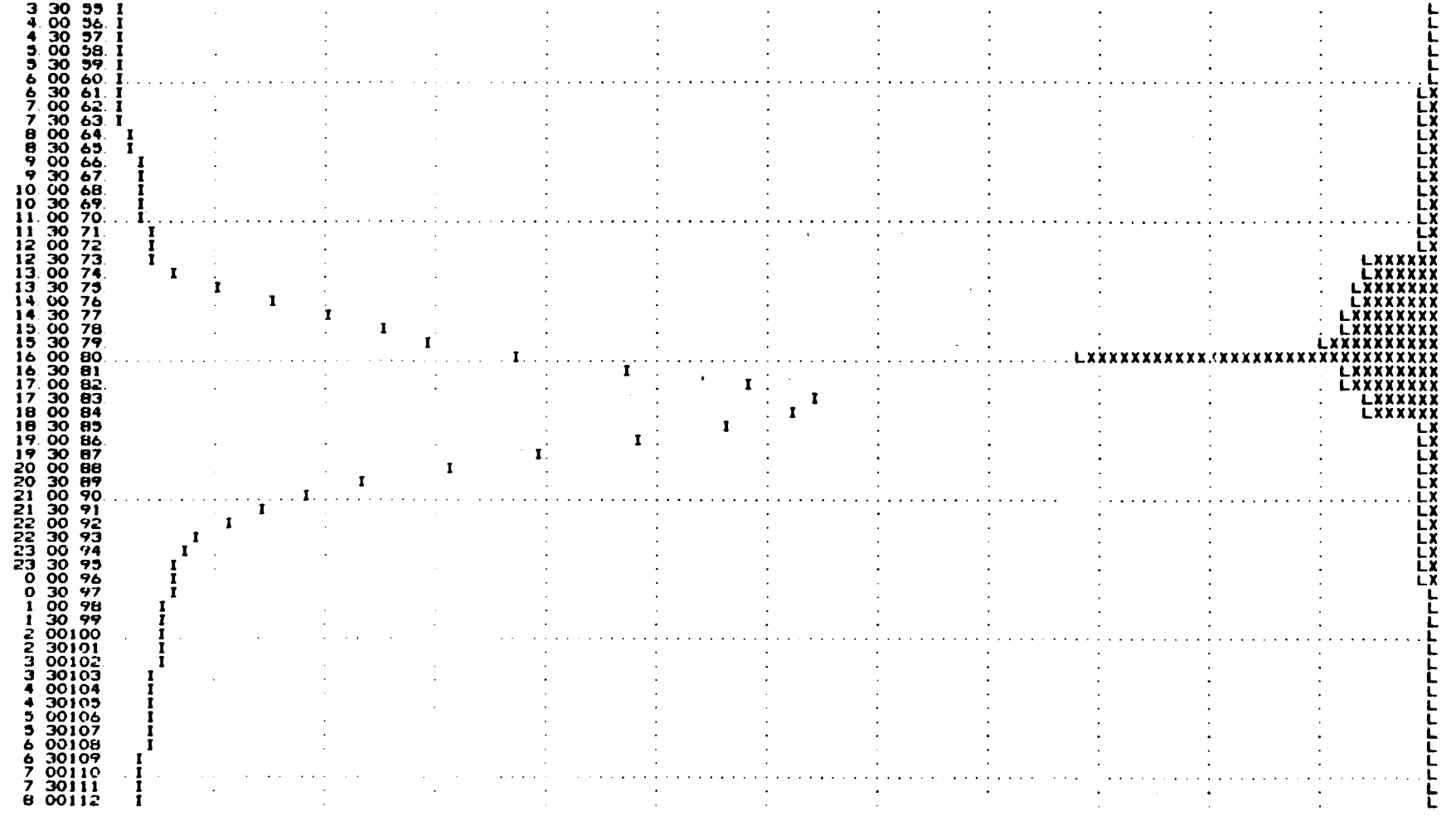
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2548	1721.	613.	261.	31372
CMS	72.	49.	17.	7.	888
INCHES		18.19	25.92	27.64	27.64
MM		461.97	658.32	701.94	701.94
AC-FT		853.	1216.	1296.	1296.
THOUS CU M		1052.	1500.	1599.	1599.

1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	400.	800.	1200.	1600.	2000.	2400.	2800.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	8.	6.	PRECIP(L) AND EXCESS(X) 4.	2.	0.
0.30	11												L
1.00	21												L
1.30	31												L
2.00	41												L
2.30	51												L
3.00	61												L
3.30	71												L
4.00	81												L
4.30	91												L
5.00	101												L
5.30	111												L
6.00	121												L
6.30	131												L
7.00	141												L
7.30	151												L
8.00	161												L
8.30	171												L
9.00	181												L
9.30	191												L
10.00	201												L
10.30	211												L
11.00	221												L
11.30	231												L
12.00	241												L
12.30	251												L
13.00	261												L
13.30	271												L
14.00	281												LX
14.30	291												LX
15.00	301												LX
15.30	311												LX
16.00	321												LX
16.30	33 I												LX
17.00	34 I												LX
17.30	35 I												L
18.00	36 I												L
18.30	37 I												L
19.00	38 I												L
19.30	39 I												L
20.00	40 I												L
20.30	41 I												L
21.00	42 I												L
21.30	43 I												L
22.00	441												L
22.30	451												L
23.00	461												L
23.30	471												L
0.00	481												L
0.30	491												L
1.00	501												L
1.30	511												L
2.00	521												L
2.30	531												L
3.00	541												L



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 8 30113   I
 9 00114   I
 9 30115   I
10 00116   I
10 30117   I
11 00118  I
11 30119  I
12 00120  I
```

1*OVN*

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1	4	7.	10.	10.	9.	8.	6.	5.
4.	3.	2	2.	1.	1.	1.	1.	1.	1.
1.	1.	2	2.	2.	2.	2.	2.	3.	3.
3.	4.	5	8.	9.	11.	12.	13.	14.	14.
14.	15.	17	23.	39.	58.	79.	98.	117.	146.
189.	232.	255	248.	222.	191.	157.	123.	94.	71.
55	42	33	26.	25.	24.	23.	22.	21.	20.
19.	19.	18	17.	16.	16.	15.	15.	14.	13.
13	12	12	11.	11.	11.	10.	10.	9.	9.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	255.	172.	61.	26.	3137.
CMS	7	5.	2.	1.	89.
INCHES		1.82	2.59	2.76	2.76
MM		46.20	65.83	70.19	70.19
AC-FT		85.	122.	130.	130.
THOUS CU M		105.	150.	160.	160.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

0	0	0	0.	0.	0.	0.	0.	0.	0.
0	0	0	0.	0.	0.	0.	0.	0.	0.
0	0	0	0.	0.	0.	0.	0.	0	0.
0	2	8	15.	20.	21.	19.	16.	13.	10.
7	6	4	3.	2.	2.	2.	2.	2.	2.
2	2	3	4.	4.	4.	5.	5.	5.	5.
6	8	11	15	19.	22.	24.	26.	27.	28.
29	29	34	49.	78.	116.	157.	196.	234.	292.
379	463	510	496.	445	382.	314.	246.	187.	142.
109	83	66	53.	49.	47.	45.	44.	42.	40.
39	37	36	34.	33.	32.	30.	29.	28.	27.
26	25	24	23.	22.	21.	20.	19.	19.	18.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	510	344.	123.	52.	6274.
CMS	14.	10.	3.	1.	178.
INCHES		3.64	5.18	5.53	5.53
MM		92.39	131.66	140.39	140.39
AC-FT		171.	243.	259.	259.
THOUS CU M		210.	300.	320.	320.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

1.	0	0	0.	0.	0.	0.	0.	0.	0.
0.	0.	0	0.	0.	0.	0.	0.	0.	0.
0.	0.	0	0.	0.	0.	0.	0.	0.	0.
0	3	11.	22	30.	31.	28.	24.	19.	15.
11.	8	6	5	3.	3.	3.	3.	3.	3.
2.	4.	5.	6.	6.	7.	7.	7.	8.	8.
9	11.	16.	23.	28.	33.	36.	39.	41.	42.
43.	44.	51	74.	117.	175.	236.	294.	351.	438.
568.	695.	764.	744.	667.	574.	471.	369.	281.	214.
164.	127.	100.	79.	74.	71.	68.	65.	63.	60.
58.	56.	53	51.	49.	47.	45.	44.	42.	40.
39.	37.	36.	34.	33.	32.	30.	29.	28.	27.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	764.	516.	184.	78.	9411.
CMS	22.	15.	5.	2.	267.
INCHES		5.46	7.78	8.29	8.29
MM		138.59	197.50	210.58	210.58
AC-FT		256.	365.	389.	389.
THOUS CU M		316.	450.	480.	480.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

1	1	1	1.	1.	1.	1.	1.	0.	0.
0	0	0	0.	0.	0.	0.	0.	0.	0.
0.	0.	0	0.	0.	0.	0.	0.	0.	0.
0	4	15	29.	40.	42.	37.	32.	26.	20.
15	11	8	6.	5.	4.	4.	4.	4.	3.
3	5	6	7.	8.	9.	9.	10.	10.	10.
11.	15.	22	30.	38.	44.	48.	52.	54.	56.
57	58	67	98.	156.	233.	314.	392.	468.	585.
738	927	1019	993.	890.	765.	628.	492.	374.	285.
219	169	133	105.	99.	95.	91.	87.	84.	80.
77.	74	71.	68.	66.	63.	61.	58.	56.	54.
51	49.	47.	46.	44.	42.	40.	39.	37.	36.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1019	688.	245.	105.	12549.
CMS	29.	19.	7.	3.	355.
INCHES		7.28	10.37	11.05	11.05
MM		184.79	263.33	280.77	280.77
AC-FT		341.	486.	519.	519
THOUS CU M		421.	600.	640.	640.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

1	1.	1	1.	1.	1.	1.	1.	1.	1.
1	1	1	1.	0.	0.	0.	0.	0.	0.
0	0	0	0	0.	0.	0.	0.	0.	0.
0	6	19	36	50.	52	47.	40	32.	25
18	14	10.	8	6.	5.	5.	5.	4.	4.
4	6	8	9	10.	11.	12.	12.	13	13.
14	19	27	38	47.	55.	60.	64.	68.	70.
71	73.	84	123	195.	291	393.	490.	585.	731
947	1158.	1274	1241.	1112.	956.	785.	614.	468.	356.
273	212	166	131.	123.	118.	114.	109.	105.	101.

97.	93.	89.	85.	82.	79.	76.	73.	70.	67.
64	62	59	57	55.	53.	50.	48.	47.	45.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1274.	860.	306.	131.	15686.
CMS	36.	24.	9.	4.	444.
INCHES		9.09	12.96	13.82	13.82
MM		230.98	329.16	350.97	350.97
AC-FT		427.	608.	648.	648.
THOUS CU M		526.	750.	800.	800.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 6

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1	1	1	1.	1.	1.	1.	1.	1.	0.
0	0	0	0.	0.	0.	0.	0.	0.	0.
1	7	23	44.	59.	62.	56.	48.	38.	30.
22	17	12	9.	7.	6.	6.	6.	5.	5.
5.	7.	9	11	12.	13.	14.	15.	15.	15.
17	23.	33	45.	57.	66.	72.	77.	81.	84.
86	87.	101.	147.	234.	349.	471.	588.	702.	877.
1136.	1390.	1529.	1489.	1334.	1147.	942.	737.	561.	427.
328	254	199	158.	148.	142.	136.	131.	126.	121.
116.	111.	107.	103.	99.	95.	91.	87.	84.	80.
77.	74.	71.	68.	66.	63.	61.	58.	56.	54.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1529.	1032.	368.	157.	18823.
CMS	43.	29.	10.	4.	533.
INCHES		10.91	15.55	16.58	16.58
MM		277.18	394.99	421.16	421.16
AC-FT		512.	729.	778.	778.
THOUS CU M		631.	900.	959.	959.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 7

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1	1	1	1	1.	1.	1.	1.	1.	1.
1	1	1	0.	0.	0.	0.	0.	1.	1.
1	8	27	51.	69.	73.	65.	55	45.	35.
26	19	14	11.	8.	7.	7.	7.	6.	6.
6	8	11	13	14.	16.	16.	17.	18.	18.
20	26	38	53	66.	77.	84.	90.	95.	98.
100	102	118	172.	272.	407.	550.	686.	819.	1023.
1326	1621.	1783	1737.	1557.	1338.	1099.	860.	655.	499.
382	296	232	184.	172.	166.	159.	153.	147.	141.
135	130	125	120.	115.	110.	106.	102.	98.	94.
90	87.	83	80.	77.	74.	71.	68	65.	63.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1783.	1204.	429.	183.	21960.
CMS	50.	34.	12.	5.	622.
INCHES		12.73	18.14	19.34	19.34
MM		323.38	460.82	491.36	491.36
AC-FT		597.	851.	907.	907.
THOUS CU M		737.	1050.	1119.	1119.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 8

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	9.	31.	58.	79.	83.	75.	63.	51.	39.
30.	22.	16.	12.	9.	8.	8.	7.	7.	7.
7.	10.	12.	15.	16.	18.	19.	20.	20.	21.
23.	30.	44.	60.	76.	88.	97.	103.	108.	112.
114.	116.	135.	176.	311.	466.	629.	784.	936.	1169.
1515.	1853.	2038.	1985.	1779.	1529.	1256.	983.	748.	570.
437.	339.	266.	210.	197.	189.	182.	174.	168.	161.
154.	148.	142.	137.	131.	126.	121.	116.	112.	107.
103.	99.	95.	91.	88.	84.	81.	78.	74.	71.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2038.	1376.	490.	209.	25097.
CMS	58.	39.	14.	6.	711.
INCHES		14.55	20.73	22.11	22.11
MM		369.57	526.66	561.55	561.55
AC-FT		683.	973.	1037.	1037.
THOUS CU M		842.	1200.	1279.	1279.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 9

2.	2.	2.	2.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	11.	38.	73.	99.	104.	94.	79.	64.	49.
37.	28.	21.	15.	11.	10.	10.	9.	9.	8.
8.	12.	15.	18.	21.	22.	23.	24.	25.	26.
29.	38.	54.	75.	95.	110.	121.	129.	135.	140.
143.	145.	168.	245.	389.	582.	786.	980.	1170.	1461.
1894.	2316.	2548.	2482.	2224.	1912.	1570.	1229.	935.	712.
546.	423.	332.	263.	246.	236.	227.	218.	209.	201.
193.	185.	178.	171.	164.	158.	151.	145.	140.	134.
129.	124.	119.	114.	109.	105.	101.	97.	93.	89.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2548.	1721.	613.	261.	31372.
CMS	72.	49.	17.	7.	888.
INCHES		18.19	25.92	27.64	27.64
MM		461.97	658.32	701.94	701.94
AC-FT		853.	1216.	1296.	1296.
THOUS CU M		1052.	1500.	1599.	1599.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING MODIFIED PLUS METHOD

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	1	0	0	0	1	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
3	0	0	0.000	0.000	0.000	0.	-1

STAGE	110.00 116.50	110.50 117.21	111.00	111.50	112.00	112.50	113.00	113.50	114.00	115.00
FLOW	0.00 779.00	8.50 1047.80	25.00	30.50	35.50	91.20	82.30	128.90	192.00	364.60
SURFACE AREA=	10.	11.	12.	13.	13.	14.				
CAPACITY=	0	21.	44.	69.	93.	123.				
ELEVATION=	110.	112.	114.	116.	118.	120.				

CREL	SPWID	COGW	EXPW	ELEVL	COGL	CAREA	EXPL
112.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COGD	EXPD	DAMWID
115.0	2.5	1.5	420

STATION 1, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	0	0	0	0.	0	0.	0	0.	0
0	0	0	0.	0.	0.	0.	0.	0.	0.
0.	0	0	1.	1.	2.	2.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	2.
2	2	2	2	2	2.	2.	2.	2.	2.
2.	2	2	3.	3.	4.	4.	5.	5.	6.
6	7	7	8	11.	16.	22	27	30	34
45.	74.	119	164.	189.	197.	188.	171.	148.	125.
108	91	78	68	59.	52.	49	46.	43.	41.
38	36	35	34	34.	33.	32.	32	31.	31.
30	29	28	28	27.	26.	26.	25	23	21.

STORAGE

0	0	0	0.	0.	0.	0.	0.	0.	0.
0	0	0	0	0.	0	0.	0	0.	0
0	0	0	0.	0.	0.	0.	0.	0.	0.
0	0	0	0	1.	1	1.	2.	2.	2.
2	2	2	2	2.	2.	2.	2.	1	1.
1	1	1	1.	1.	1.	1.	1	1	1
1	1	1	2.	2.	2.	2.	3.	3.	3.
4	4	4	5	6	7	9.	12	15	19.
25	31	37	42	44.	45.	44.	42.	40.	38.
36	34	32	30	28.	27.	26.	25	24	23
22	21	21	20.	19.	19.	18.	17.	16.	16.
15	14	14	13	12.	12.	11.	10	10	9

STAGE

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.1	110.1	110.1	110.2	110.2	110.2
110.2	110.2	110.2	110.2	110.2	110.2	110.2	110.2	110.1	110.1
110.1	110.1	110.1	110.1	110.1	110.1	110.1	110.1	110.1	110.1
110.1	110.1	110.1	110.2	110.2	110.2	110.2	110.3	110.3	110.3
110.4	110.4	110.4	110.5	110.6	110.7	110.9	111.2	111.5	111.8
112.3	112.9	113.4	113.8	114.0	114.0	114.0	113.8	113.7	113.5
113.3	113.1	112.9	112.8	112.6	112.5	112.4	112.3	112.2	112.2
112.1	112.0	112.0	111.9	111.8	111.8	111.7	111.6	111.6	111.5
111.4	111.4	111.3	111.2	111.2	111.1	111.1	111.0	110.9	110.9

PEAK OUTFLOW IS 197. AT TIME 43.00 HOURS

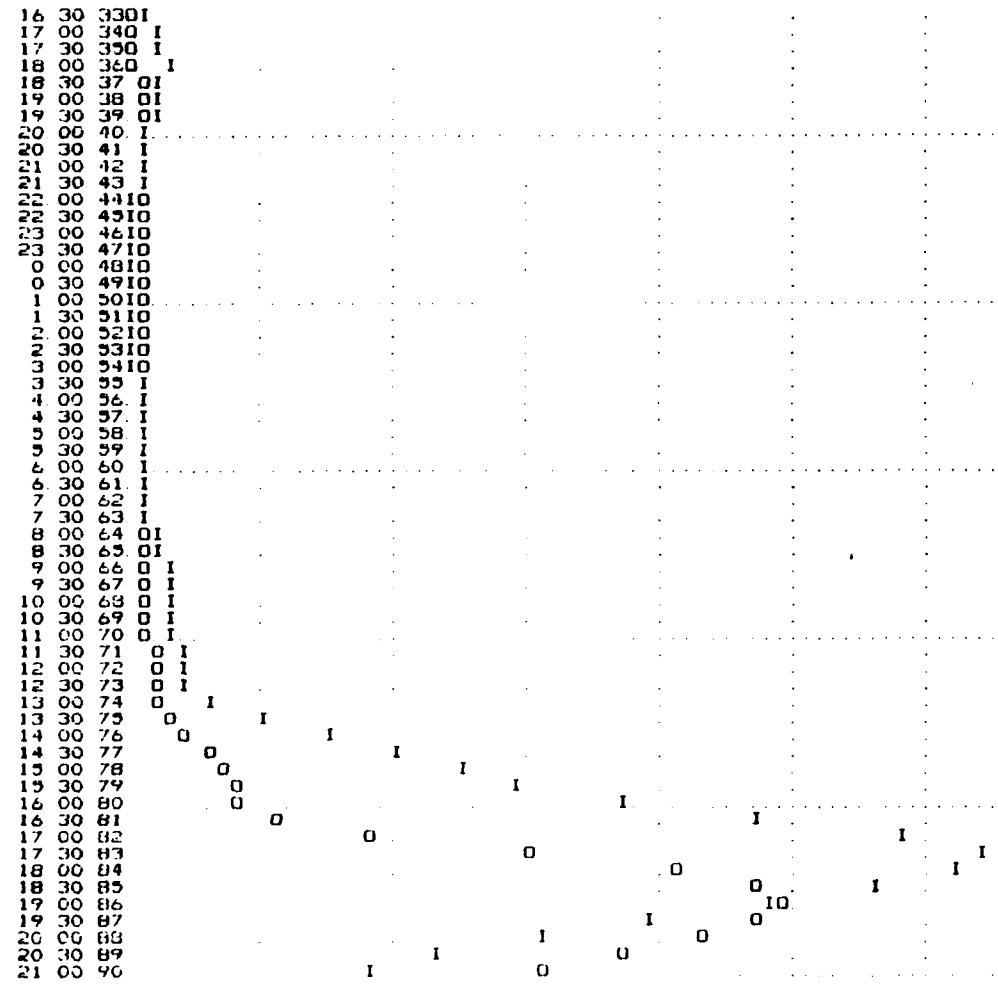
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	197	137.	58.	24.	2915.
CMS	6.	4.	2.	1.	83.
INCHES		1.45	2.47	2.57	2.57
MM		36.84	62.68	65.22	65.22
AC-FT		68.	116.	120.	120.
THOUS CU M		84.	143.	149.	149.

1*DVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0	40.	80.	120	160.	200.	240.	280.	0.	0.	0.	0.	0.
0	30	11											
1	00	21											
1	30	31											
2	00	41											
2	30	51											
3	00	61											
3	30	71											
4	00	81											
4	30	91											
5	00	101											
5	30	111											
6	00	121											
6	30	131											
7	00	141											
7	30	151											
8	00	161											
8	30	171											
9	00	181											
9	30	191											
10	00	201											
10	30	211											
11	00	221											
11	30	231											
12	00	241											
12	30	251											
13	00	261											
13	30	271											
14	00	281											
14	30	291											
15	00	301											
15	30	311											
16	00	321											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0 30 4910
1 00 5010
1 30 5110
2 00 5210
2 30 5310
3 00 5410
3 30 55 I
4 00 56 I
4 30 57 I
5 00 58 I
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6 30 61 I
7 00 62 I
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8 30 65 OI
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17 00 82 O I
17 30 83 O I
18 00 84 O I
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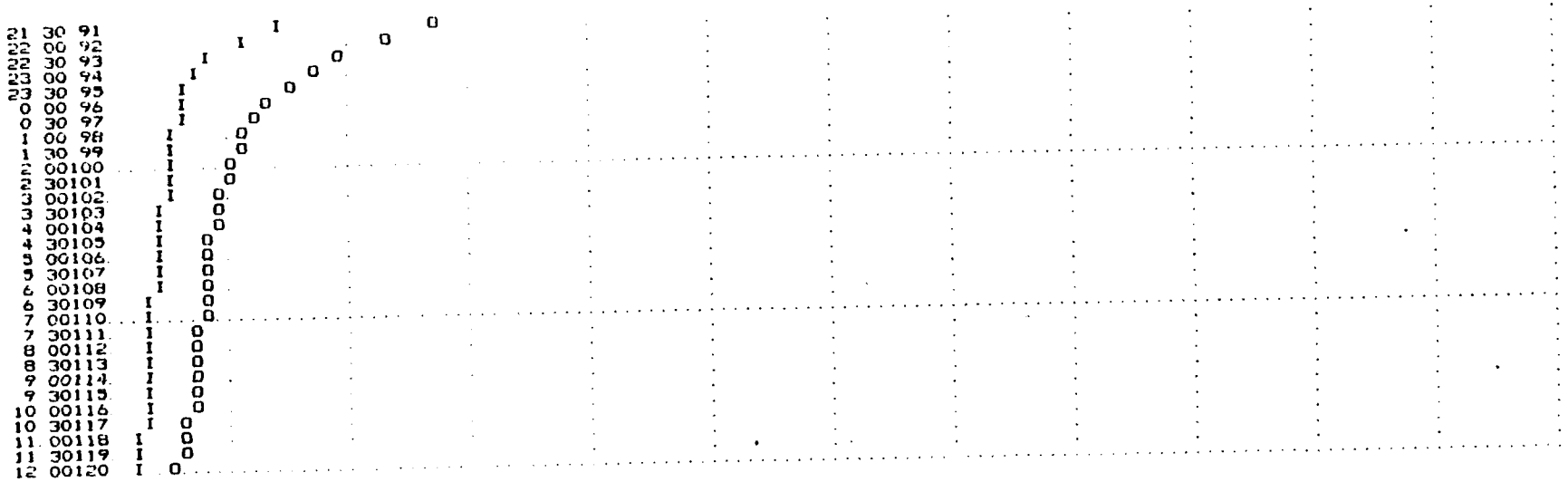
19 30 87 I O
20 00 88 I O
20 30 89 I O
21 00 90 I O

FLAHERTY GIAVARA ASSOCIATES, P C



1*DVN*

STATION 1, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	1	2	4	5	5	6	6
7	7	6	6	6	6	5	5	5	5
5	4	4	4	4	4	4	4	4	4
4	5	5	5	6	7	8	10	12	14
16	17	19	22	26	29	33	43	71	121
197	299	405	520	460	407	358	323	275	225
182	152	125	107	91	80	73	67	62	58
54	51	49	48	46	45	43	42	40	39
38	36	35	35	34	34	33	33	32	32

STORAGE

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	2	3	3	4	4

4	4	4	4	4	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3
3	3	3	3	4	4	5	6	6	7
7	8	8	9	11	14	18	24	30	37
45	52	57	59	58	57	56	53	50	47
43	40	38	36	34	32	31	30	29	28
27	27	26	26	25	25	24	23	23	22
22	21	21	20	20	19	19	18	18	17

STAGE

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.1	110.1	110.2	110.3	110.3	110.4	110.4
110.4	110.4	110.4	110.4	110.4	110.3	110.3	110.3	110.3	110.3
110.3	110.3	110.3	110.3	110.2	110.2	110.3	110.3	110.3	110.3
110.3	110.3	110.3	110.3	110.4	110.4	110.3	110.3	110.5	110.7
110.7	110.8	110.8	110.9	111.1	111.3	111.7	112.2	112.8	113.4
114.0	114.6	115.1	115.2	115.1	115.1	115.0	114.8	114.5	114.2
113.9	113.7	113.5	113.3	113.1	113.0	112.9	112.8	112.7	112.6
112.9	112.9	112.4	112.4	112.3	112.3	112.2	112.2	112.2	112.1
112.1	112.0	112.0	111.9	111.9	111.8	111.8	111.7	111.7	111.6

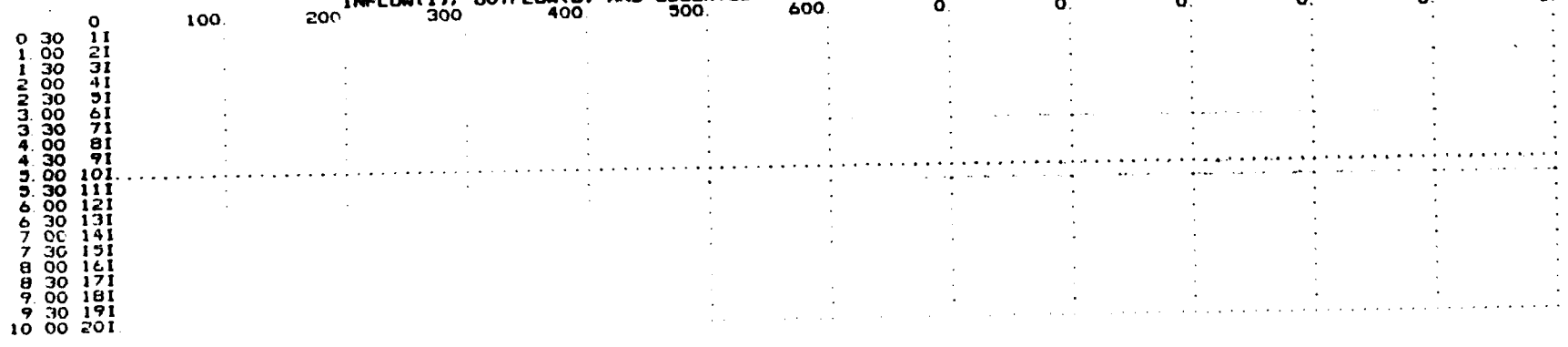
PEAK OUTFLOW IS 520. AT TIME 42.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	520	316.	117.	49.	5859.
CMS	15	9.	3.	1.	166.
INCHES		3.34	4.93	5.16	5.16
MM		84.73	125.79	131.09	131.09
AC-FT		156.	232.	242.	242.
THOUS CU M		193.	287.	299.	299.

1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)



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11 30 71  0I
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12 30 73  0I
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14 00 76   0       I
14 30 77   0          I
15 00 78    0             I
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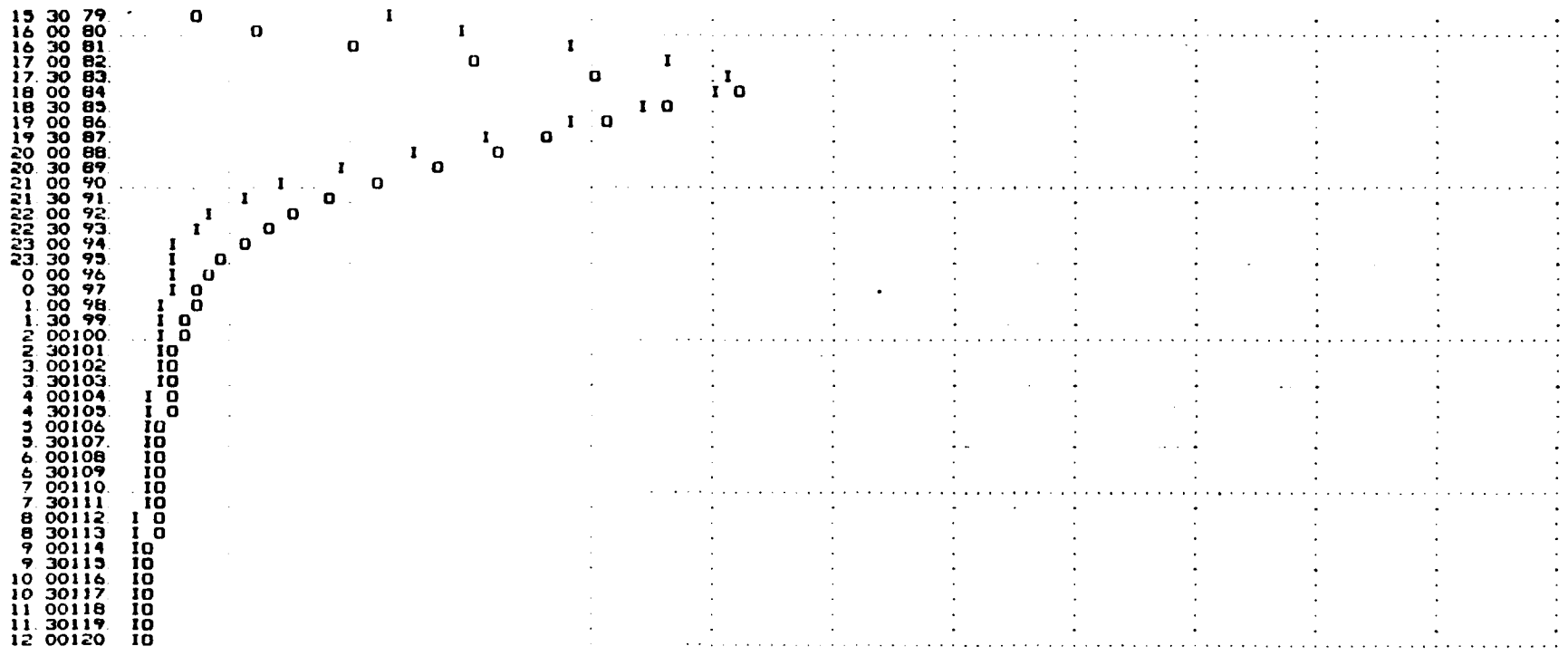


1*OVN*

STATION 1, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	2	3	5	7	8	9	10
11	11	10	10	9	8	8	8	7	7
7	6	6	6	6	6	6	6	6	6

7	7	7	8	10.	12.	15.	18.	21.	23.
25	26	27	28	31.	35.	55.	103.	175.	271.
387	688	744	758	688.	599.	502.	406.	347.	302.
251	203	168	140.	120.	106.	96.	88.	81.	77.
74	70	67	64	61.	59.	56.	54.	52.	50.
49	48	47	45	44.	43.	41.	40.	39.	38.

STORAGE

0	0	0	0	0.	0.	0.	0.	0.	0.
0	0	0	0	0.	0.	0.	0	0.	0.
0	0	0	0	0.	0.	0.	0	0.	0.
0	0	0	1	2.	3.	4	5	5.	6.
6	6	6	5	5	5.	5	5	4.	4.
4	4	4	4	4.	4.	4	4.	4	4.
4	4	4	5	6.	6.	7.	8	9.	10.
10.	11.	12	13	16.	21.	27.	35.	43.	50.
57	61	61	62	61.	60.	59.	57.	55.	52.
48	45	42	39	37.	35.	34.	33.	32.	32.
31	30	30	29	29.	28.	28.	27.	27.	26.
26	26	25	25.	24.	24.	23.	23.	22.	22.

STAGE

110 0	110 0	110 0	110 0	110.0	110.0	110.0	110.0	110.0	110.0
110 0	110.0	110 0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110 0	110 0	110 0	110 0	110.0	110.0	110.0	110.0	110.0	110.0
110 0	110 0	110 0	110 1	110.2	110.3	110.4	110.5	110.5	110.6
110 6	110 6	110 5	110 5	110.5	110 5	110.5	110.4	110.4	110.4
110 4	110 4	110 4	110 4	110.4	110.4	110.4	110.4	110.4	110.4
110 4	110 4	110 4	110 5	110.5	110.6	110.7	110.8	110.9	110.9
111 0	111 1	111 2	111 3	111.5	112.0	112.6	113.2	113.9	114.5
115 0	115 4	115 4	115 4	115.4	115.3	115.2	115.1	114 9	114.6
114 3	114.1	113 8	113.6	113.4	113.3	113.1	113.1	113.0	112.9
112 9	112 8	112 8	112.7	112.7	112.6	112.6	112.5	112.5	112.5
112 4	112 4	112 4	112 3	112.3	112.2	112.2	112.1	112.1	112.1

PEAK OUTFLOW IS 758. AT TIME 42 00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	758	492.	177.	74	8881.
CMS	21	14.	5.	2.	251.
INCHES		5.20	7.50	7.82	7.82
MM		132.19	190.43	198.72	198.72
AC-FT		244.	352.	367.	367.
THOUS CU M		301.	434.	453.	453.

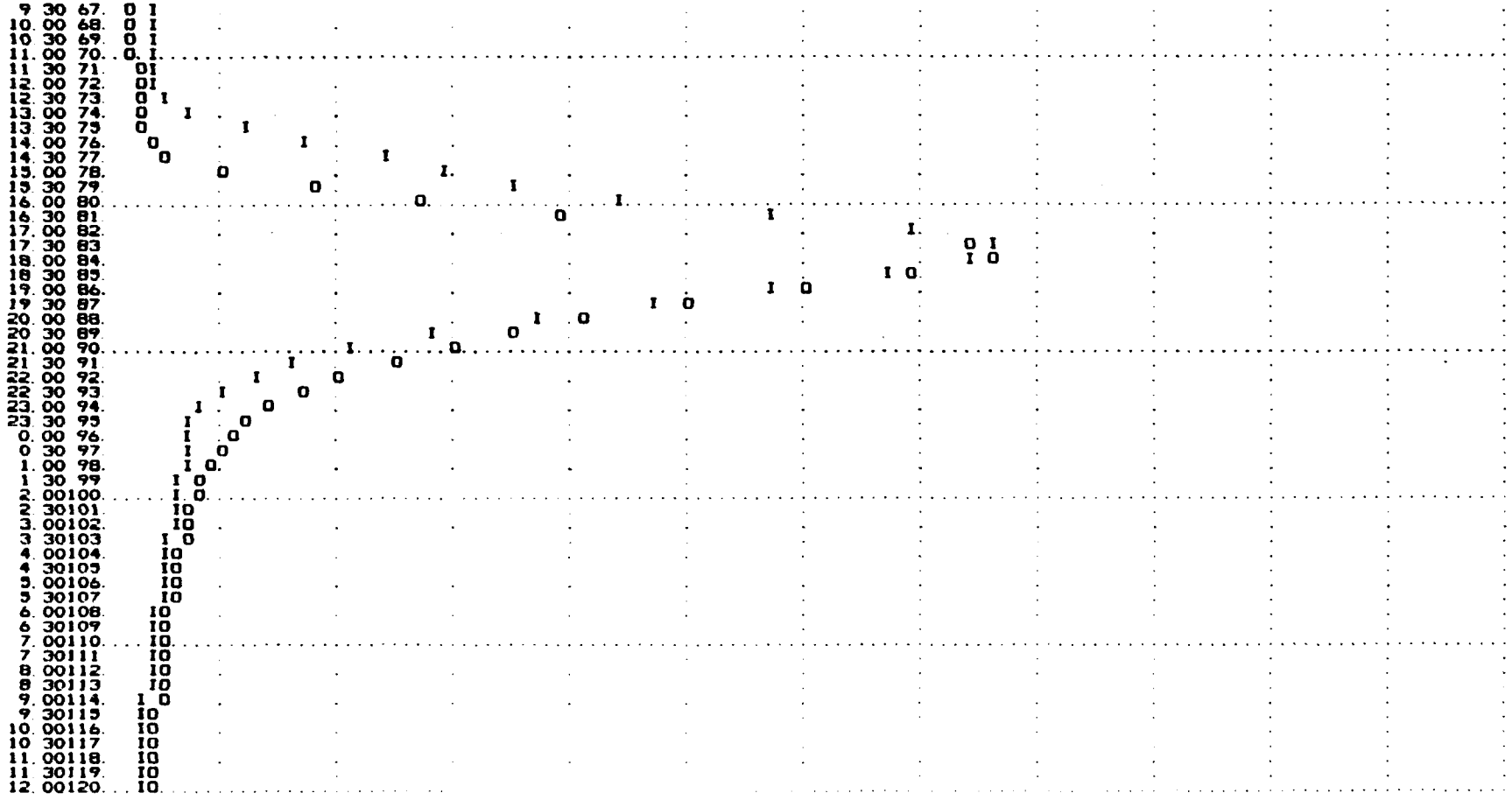
1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0	100	200	300	400	500.	600.	700.	800	0.	0.	0.	0.
0 30	1I												
1 00	2I												
1 30	3I												
2 00	4I												
2 30	5I												
3 00	6I												
3 30	7I												
4 00	8I												

```
 4 30  91
 5 00 101
 5 30 111
 6 00 121
 6 30 131
 7 00 141
 7 30 151
 8 00 161
 8 30 171
 9 00 181
 9 30 191
10 00 201
10 30 211
11 00 221
11 30 231
12 00 241
12 30 251
13 00 261
13 30 271
14 00 281
14 30 291
15 00 301
15 30 311
16 00 321
16 30 3301
17 00 340  I
17 30 350   I
18 00 36 0 I
18 30 37 0 I
19 00 38 01
19 30 39 01
20 00 40 I
20 30 41 I
21 00 42 I
21 30 43 I
22 00 4410
22 30 4510
23 00 4610
23 30 4710
 0 00 4810
 0 30 4910
 1 00 5010
 1 30 5110
 2 00 5210
 2 30 5310
 3 00 54 I
 3 30 55 I
 4 00 56 I
 4 30 57 I
 5 00 58 I
 5 30 59 I
 6 00 60 I
 6 30 61 I
 7 00 62 I
 7 30 63 C:
 8 00 64 01
 8 30 65 0 I
 9 00 66 0 I
```



1*OVN*

STATION 1, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	2	5	7	10	13	15	16
16	16	15	14	13	12	11	10	9	8
8	8	8	8	8	8	8	8	8	8
8	9	10	12	15	18	21	25	26	27
29	30	31	33	38	59	110	193	301	452
733	883	1009	1004	915	793	662	530	414	349
305	255	208	172	147	129	119	110	103	97
92	87	83	80	78	75	72	70	67	65
62	60	58	55	53	51	50	49	48	47

STORAGE

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	1	3	4	5	6	7	7
7	7	7	7	6	6	6	6	5	5
5	5	5	5	5	5	5	5	5	5
5	5	6	6	7	8	9	10	11	13
14	15	16	18	22	28	36	44	52	58
61	63	64	64	63	62	61	59	58	55
52	49	45	42	40	38	37	36	35	34
34	33	33	32	32	31	31	30	30	29
29	28	28	28	27	27	26	26	26	25

STAGE

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.1	110.1	110.3	110.4	110.5	110.6	110.7	110.7
110.7	110.7	110.7	110.7	110.6	110.6	110.6	110.5	110.5	110.5
110.5	110.5	110.5	110.5	110.5	110.5	110.5	110.5	110.5	110.5
110.5	110.5	110.5	110.6	110.7	110.8	110.9	111.0	111.1	111.2
111.3	111.4	111.6	111.7	112.1	112.6	113.3	114.0	114.6	115.1
115.4	115.5	115.6	115.6	115.5	115.4	115.3	115.2	115.1	114.9
114.7	114.4	114.1	113.8	113.6	113.5	113.4	113.3	113.2	113.2
113.1	113.1	113.0	113.0	112.9	112.9	112.8	112.8	112.8	112.7
112.7	112.6	112.6	112.6	112.5	112.5	112.5	112.4	112.4	112.4

PEAK OUTFLOW IS 1009. AT TIME 41.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1009	671	239	100	11942
CMS	29.	19.	7.	3.	338.
INCHES		7.09	10.09	10.52	10.52
MM		180.09	256.16	267.21	267.21
AC-FT		333	473	493	493
THOUS CU M		410.	584.	609.	609.

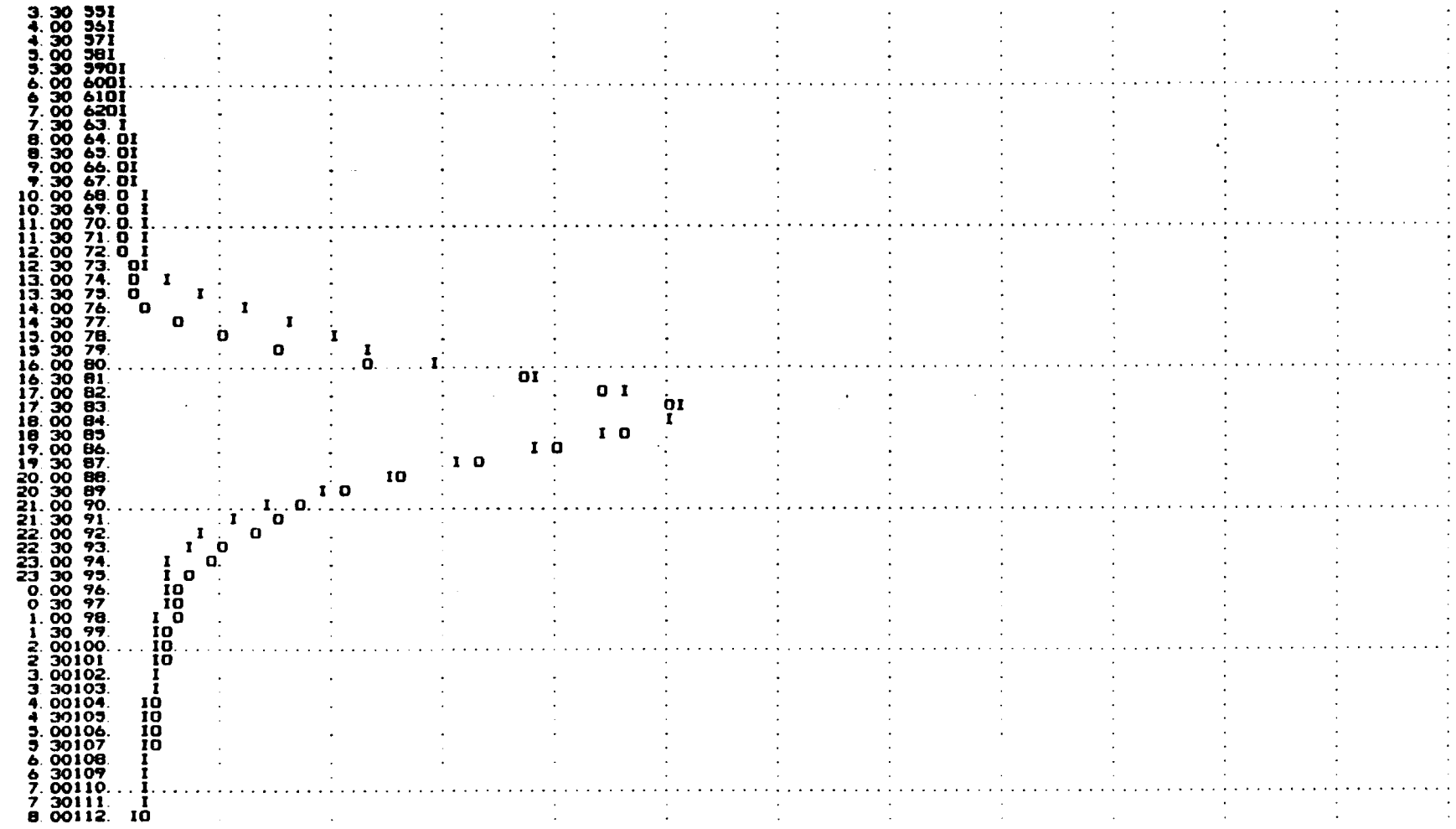
1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0. 200. 400. 600. 800. 1000. 1200. 0. 0. 0. 0. 0. 0.

0 30 1I
1 00 2I
1 30 3I
2 00 4I
2 30 5I
3 00 6I
3 30 7I
4 00 8I
4 30 9I
5 00 10I
5 30 11I
6 00 12I
6 30 13I
7 00 14I
7 30 15I
8 00 16I
8 30 17I
9 00 18I
9 30 19I
10 00 20I
10 30 21I
11 00 22I
11 30 23I
12 00 24I
12 30 25I
13 00 26I
13 30 27I
14 00 28I
14 30 29I
15 00 30I
15 30 31I
16 00 32I
16 30 330I
17 00 340I
17 30 350 I
18 00 360 I
18 30 370 I
19 00 38. OI
19 30 39 I
20 00 40. I
20 30 41 I
21 00 42. I
21 30 4310
22 00 4410
22 30 4510
23 00 4610
23 30 4710
0 00 48I
0 30 49I
1 00 50I
1 30 51I
2 00 52I
2 30 53I
3 00 54I


3.30 551
4.00 561
4.30 571
5.00 581
5.30 5901
6.00 6001
6.30 6101
7.00 6201
7.30 63. I
8.00 64. OI
8.30 65. OI
9.00 66. OI
9.30 67. OI
10.00 68. O I
10.30 69. O I
11.00 70. O. I
11.30 71. O I
12.00 72. O I
12.30 73. OI
13.00 74. O I
13.30 75. O I
14.00 76. O I
14.30 77. O I
15.00 78. O I
15.30 79. O I
16.00 80. O I
16.30 81. OI
17.00 82. O I
17.30 83. OI
18.00 84. I
18.30 85. I O
19.00 86. I O
19.30 87. I O
20.00 88. IO
20.30 89. I O
21.00 90. I O
21.30 91. I O
22.00 92. I O
22.30 93. I O
23.00 94. I O
23.30 95. I O
0.00 96. IO
0.30 97. IO
1.00 98. I O
1.30 99. IO
2.00100. IO
2.30101 IO
3.00102. I
3.30103. I
4.00104. IO
4.30105. IO
5.00106. IO
5.30107 IO
6.00108. I
6.30109 I
7.00110. I
7.30111. I
8.00112. IO

```
  8 30113  IO
  9 00114  IO
  9 30115  IO
 10 00116  IO
 10 30117  IO
 11 00118  I
 11 30119  I
 12 00120  I
```

1*OVN*

STATION 1, PLAN 1, RATIO 5

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0	0	0	0	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	0	0	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	3.	6.	9.	14.	17.	20.	21.
21	20	19	18	17.	15.	14.	13.	12.	11.
10.	9.	9.	9.	9.	9.	10.	10.	10.	11.
11	12	13	15	19.	23.	26.	27.	29.	30.
32.	33	35	42	57.	100.	179.	295.	457.	714.
885	1123	1258	1257	1140.	988.	823.	656.	508.	396.
343.	298.	248	203.	173.	154.	141.	130.	123.	117.
112.	107.	103	98.	94.	90.	87.	83.	80.	78.
76	73.	71	68.	66.	63.	61.	59.	56.	54.

STORAGE

0	0	0	0.	0.	0.	0.	0.	0.	0.
0	0	0	0	0.	0.	0.	0.	0.	0.
0	0	0	0	0.	0.	0.	0.	0.	0.
0	0	1	2.	3.	5	7.	8.	9.	9.
9	9	9	8.	8.	7.	7.	6.	6.	6.
6	5	5	5	5.	5.	5.	6.	6.	6.
6	6	7	7	8.	10.	11.	12.	14.	16.
17	19	21	23	28.	35.	43.	52.	58.	61.
63	65	66.	66.	65.	64.	62.	61.	59.	57.
55	52	48	45	43.	41.	39.	38.	38.	37.
36	36	35	34.	34.	34.	33.	33.	32.	32.
31	31	30	30.	29.	29.	29.	28.	28.	27.

STAGE

110 0	110 0	110 0	110 0	110 0	110.0	110.0	110.0	110.0	110.0
110 0	110 0	110 0	110 0	110.0	110.0	110.0	110.0	110.0	110.0
110 0	110 0	110 0	110 0	110.0	110.0	110.0	110.0	110.0	110.0
110 0	110 0	110 1	110 2	110.3	110.5	110.7	110.8	110.8	110.9
110 9	110 9	110 8	110 8	110.7	110.7	110.7	110.6	110.6	110.6
110 5	110 5	110 5	110 5	110.5	110.5	110.5	110.5	110.6	110 6
110.6	110 6	110.6	110.7	110.8	110.9	111.1	111.2	111.3	111.5
111 6	111 8	112 0	112 2	112.6	113.2	113.9	114.6	115.1	115.4
115 5	115 7	115 8	115 8	115.7	115.6	115.5	115.3	115.2	115.1
114 9	114 6	114 3	114 1	113 9	113.7	113.6	113.5	113.4	113.4
113 3	113 3	113 2	113.2	113.1	113.1	113.0	113.0	113.0	112.9
112 9	112 9	112 8	112 8	112 7	112 7	112 7	112 6	112 6	112 5

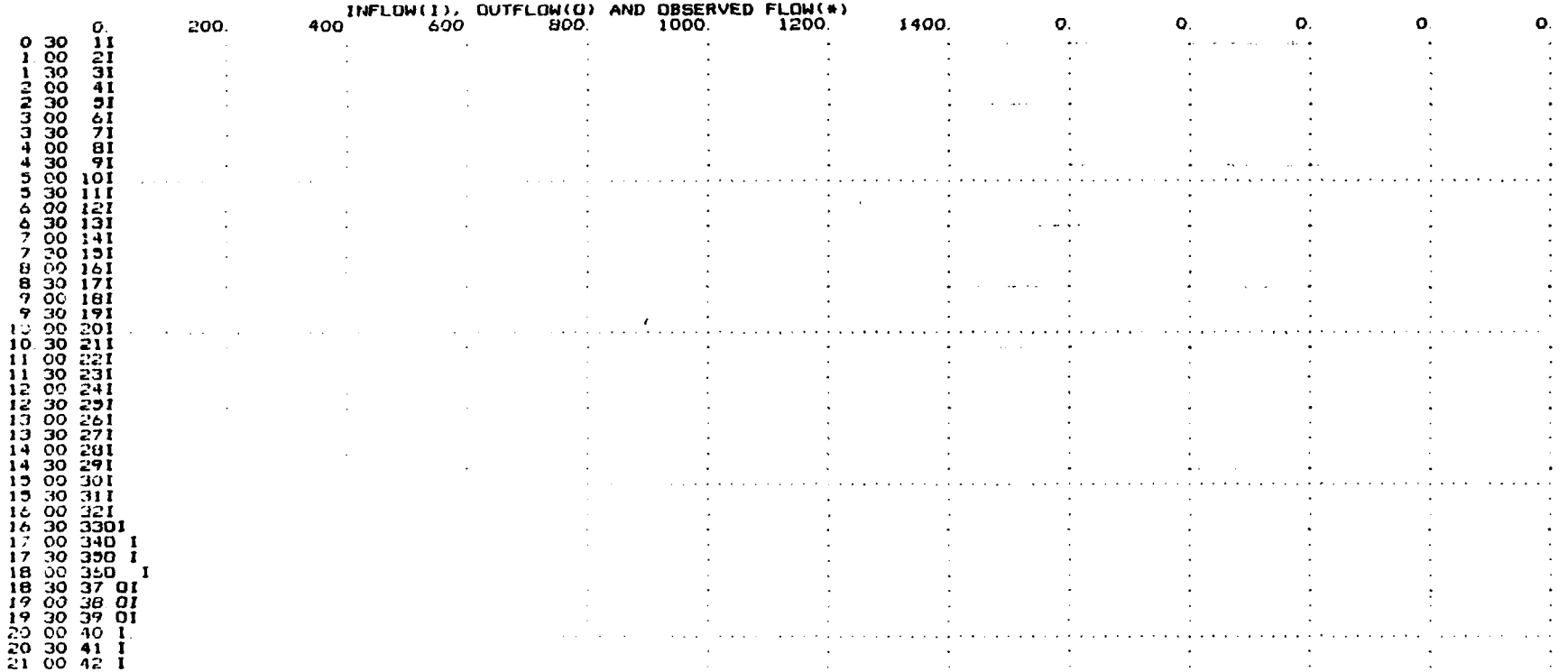
PEAK OUTFLOW IS 1258. AT TIME 41 50 HOURS

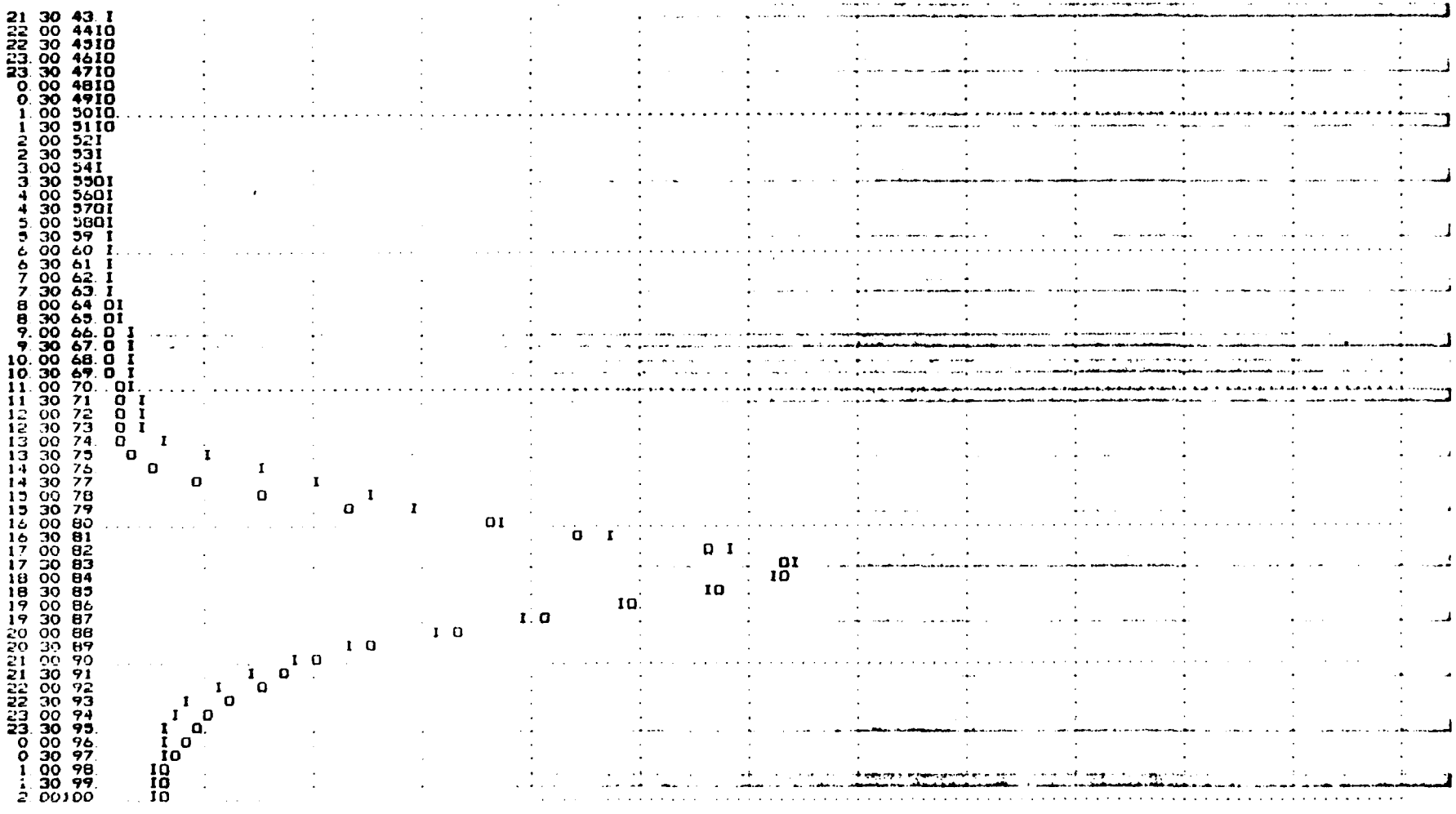
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1258	846.	300.	125.	15026.
CMS	36.	24.	9.	4.	425.
INCHES		8.95	12.70	13.24	13.24
MM		227.24	322.52	336.21	336.21
AC-FT		420.	596.	621.	621.
THOUS CU M		518	735	766.	766.

1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)




21 30 43 I
22 00 44 IO
22 30 45 IO
23 00 46 IO
23 30 47 IO
0 00 48 IO
0 30 49 IO
1 00 50 IO
1 30 51 IO
2 00 52 I
2 30 53 I
3 00 54 I
3 30 55 OI
4 00 56 OI
4 30 57 OI
5 00 58 OI
5 30 59 I
6 00 60 I
6 30 61 I
7 00 62 I
7 30 63 I
8 00 64 OI
8 30 65 OI
9 00 66 O I
9 30 67 O I
10 00 68 O I
10 30 69 O I
11 00 70 OI
11 30 71 O I
12 00 72 O I
12 30 73 O I
13 00 74 O I
13 30 75 O I
14 00 76 O I
14 30 77 O I
15 00 78 O I
15 30 79 O I
16 00 80 OI
16 30 81 O I
17 00 82 O I
17 30 83 OI
18 00 84 IO
18 30 85 IO
19 00 86 IO
19 30 87 I O
20 00 88 I O
20 30 89 I O
21 00 90 I O
21 30 91 I O
22 00 92 I O
22 30 93 I O
23 00 94 I O
23 30 95 I O
0 00 96 I O
0 30 97 IO
1 00 98 IO
1 30 99 IO
2 00 100 IO

```
  2 30101     IO
  3 00102      I
  3 30103     IO
  4 00104     IO
  4 30105     IO
  5 00106     IO
  5 30107      I
  6 00108      I
  6 30109     IO
  7 00110     IO
  7 30111     IO
  8 00112     IO
  8 30113     IO
  9 00114      I
  9 30115      I
 10 00116      I
 10 30117      I
 11 00118     IO
 11 30119     IO
 12 00120     IO
```

1*DUMP

STATION 1, PLAN 1, RATIO 6

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

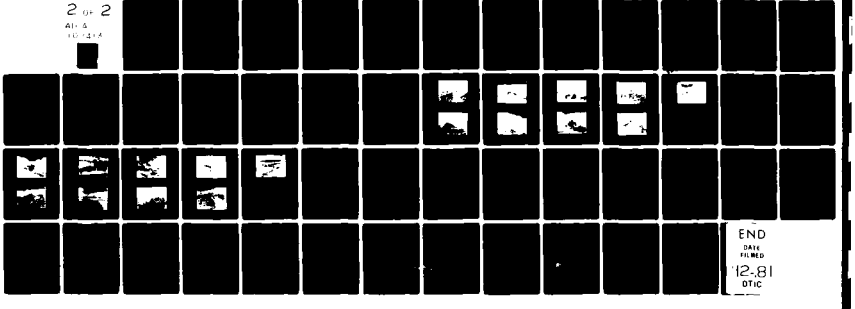
0	0	0	0	0.	0.	0.	0.	0.	0.
0	0	0	0.	0.	0.	0.	1.	1.	1.
1	0	0	0.	0.	0.	0.	0.	0.	0.
0	1	2	4	7	12	18	22	25	25.
25	25	24	22.	20.	19.	17.	16.	15.	13.
12	12	11	11.	11.	11.	12.	12.	12	13.
13	14	16	18.	22.	26.	28.	30.	31.	33.
35	40	46	58	85	148	256	395	706	820.
1083	1345	1514	1506.	1366.	1183.	985.	783	604	466.
370	332	284	236.	190.	178	164.	153.	144	137.
130	125	121	116	112.	107.	103.	99.	95.	92.
88	84	81	79	77.	74	72.	69.	67.	64.

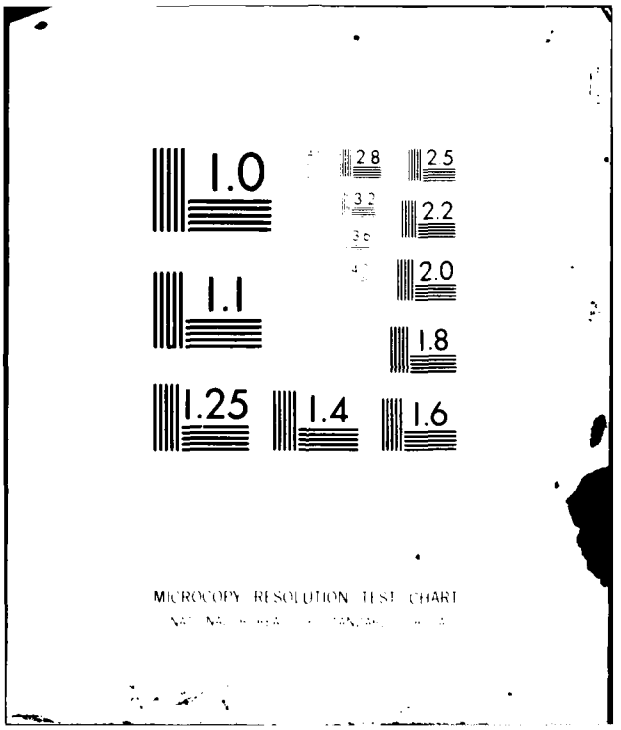
STORAGE

0	0	0	0.	0.	0.	0.	0.	0.	0.
0	0	0	0	0.	0	0	0.	0.	0
0	0	0	0	0.	0	0	0.	0	0.
0	0	1	2	4.	6	8.	9.	10.	11
11	10	10	9	9.	8	8.	7.	7.	7.
6	6	6	6	6	6	6	6	6	6
7	7	7	8	10	11	13	15.	17	19
21	23	25	28	33.	40	49.	57.	61.	62
64	67	68	68	67.	65	64.	62.	60.	58.
57	54	51	47	45	43	42	41.	40	39
38	38	37	37	36	36	35	35	34	34
33	33	32	32	31	31	31	30.	30.	29

STAGE

AD-A107 413 FLAHERTY-GIAVARA ASSOCIATES NEW HAVEN CT F/G 13/13
NATIONAL DAM SAFETY PROGRAM. ROBERT L. BISHOP DAM (INVENTORY NU--ETC(U)
AUG 81 H C FLAHERTY DACW51-81-C-0006
UNCLASSIFIED NL




1.0
2.8
2.5
3.2
2.2
3.6
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.1	110.2	110.4	110.6	110.8	110.9	111.0	111.0
111.0	111.0	111.0	110.9	110.9	110.8	110.8	110.7	110.7	110.6
110.6	110.6	110.6	110.6	110.6	110.6	110.6	110.6	110.6	110.6
110.6	110.7	110.7	110.8	110.9	111.1	111.2	111.4	111.6	111.8
112.0	112.2	112.3	112.6	113.0	113.7	114.4	115.1	115.4	115.5
115.6	115.8	115.9	115.9	115.8	115.7	115.6	115.4	115.3	115.1
115.0	114.8	114.5	114.3	114.0	113.9	113.8	113.7	113.6	113.6
113.5	113.5	113.4	113.4	113.3	113.3	113.2	113.2	113.1	113.1
113.1	113.0	113.0	112.9	112.9	112.9	112.8	112.8	112.8	112.7

PEAK OUTFLOW IS 1514. AT TIME 41.50 HOURS

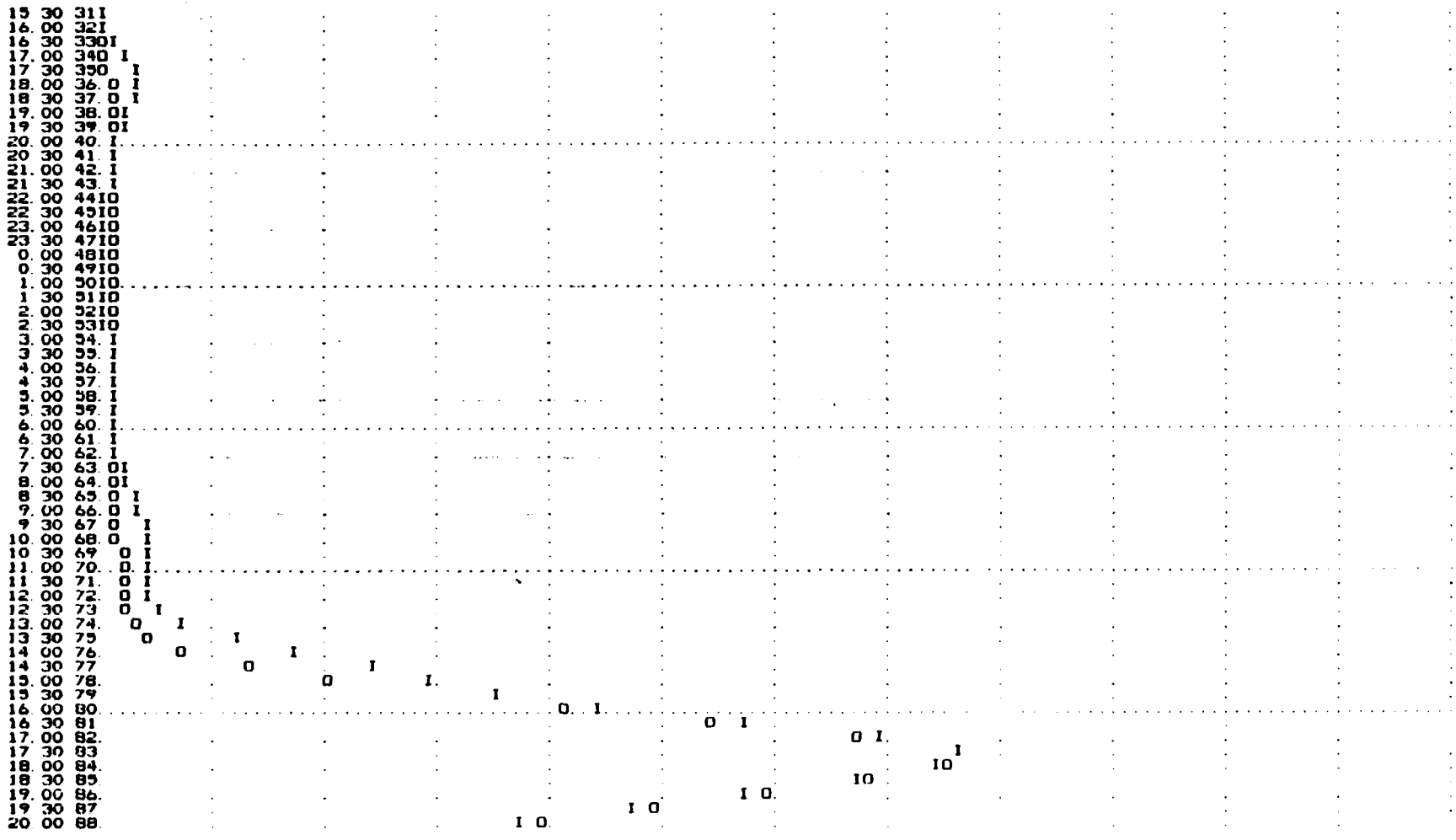
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1514	1027	362.	151.	18118
CMS	43.	29.	10.	4.	513.
INCHES		10.86	15.32	15.96	15.96
MM		275.78	389.10	405.40	405.40
AC-FT		509	719.	749.	749
THOUS CU M		628.	886.	924.	924.

1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	200.	400.	600.	800.	1000.	1200.	1400.	1600.	0.	0.	0.	0.
0 30	1I												
1.00	2I												
1 30	3I												
2.00	4I												
2 30	5I												
3.00	6I												
3 30	7I												
4.00	8I												
4 30	9I												
5.00	10I												
5 30	11I												
6.00	12I												
6 30	13I												
7.00	14I												
7 30	15I												
8.00	16I												
8 30	17I												
9.00	18I												
9 30	19I												
10.00	20I												
10 30	21I												
11.00	22I												
11 30	23I												
12.00	24I												
12 30	25I												
13.00	26I												
13 30	27I												
14.00	28I												
14 30	29I												
15.00	30I												


15 30 311
16.00 321
16 30 330I
17.00 340 I
17 30 350 I
18.00 36.0 I
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19.00 38.0I
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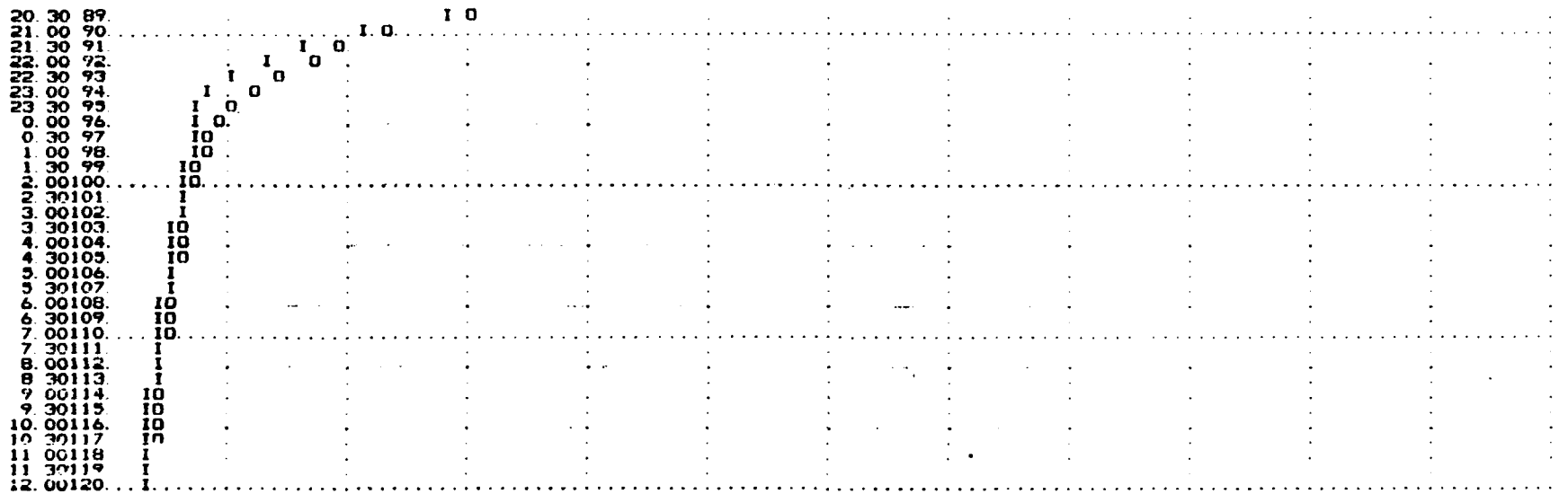
20.00 40.I
20 30 41.I
21.00 42.I
21 30 43.I
22.00 4410
22 30 4510
23.00 4610
23 30 4710
0.00 4810
0.30 4910
1.00 5010
1 30 5110
2.00 5210
2 30 5310
3.00 54.I
3 30 55.I
4.00 56.I
4 30 57.I
5.00 58.I
5.30 59.I
6.00 60.I
6 30 61.I
7.00 62.I
7 30 63.0I
8.00 64.0I
8 30 65.0 I
9.00 66.0 I
9 30 67.0 I
10.00 68.0 I
10 30 69 0 I
11.00 70. 0.I
11 30 71. 0 I
12.00 72. 0 I
12 30 73 0 I
13.00 74. 0 I
13 30 75 0 I
14 00 76. 0 I
14 30 77 0 I
15.00 78. 0 I.
15 30 79 I
16 00 80. 0. I
16 30 81 0 I
17.00 82. 0 I.
17 30 83 I
18.00 84. 10
18 30 85 10
19.00 86. I 0.
19 30 87 I 0
20 00 88. I 0.



1*OVN*

STATION 1, PLAN 1, RATIO 7

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	2	4	8	15	22	26	27	27
27	27	27	26	25	24	22	20	18	17
15	14	14	14	14	14	14	14	15	15
16	17	18	22	25	27	30	32	34	38
45	51	62	79	118	196	324	602	804	967
1265	1573	1767	1757	1592	1378	1146	909	701	539
421	353	313	266	226	200	185	174	166	158
151	144	138	132	127	123	119	115	111	106
102	98	95	91	87	84	81	79	76	74

STORAGE

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0	0	0
0.	0.	1.	3.	5.	7.	9.	11.	12.	12.
13	12	12	11	11	10.	9.	9	8	8.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7	8	8	9	11	13.	15.	17.	20.	22.
24	27.	29.	32.	37.	45.	54.	60.	62	63.
66	68	70	69.	68.	67.	65.	63.	61.	59
58.	56.	53.	49.	47.	45.	44.	43.	42.	41.
40	40	39	39.	38.	38.	37	37.	36.	36.
35.	35.	34.	34.	33.	33.	32.	32.	31.	31.

STAGE

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.1	110.3	110.5	110.7	110.9	111.1	111.1	111.2
111.2	111.2	111.1	111.1	111.0	111.0	110.9	110.8	110.8	110.8
110.7	110.7	110.7	110.7	110.7	110.7	110.7	110.7	110.7	110.7
110.7	110.7	110.8	110.9	111.0	111.2	111.4	111.6	111.9	112.1
112.3	112.5	112.7	112.9	113.4	114.0	114.8	115.3	115.4	115.6
115.8	115.9	116.0	116.0	115.9	115.8	115.7	115.5	115.4	115.2
115.1	114.9	114.7	114.4	114.2	114.0	113.9	113.9	113.8	113.7
113.7	113.6	113.6	113.5	113.5	113.4	113.4	113.3	113.3	113.3
113.2	113.2	113.1	113.1	113.1	113.0	113.0	112.9	112.9	112.9

PEAK OUTFLOW IS 1767. AT TIME 41.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1767.	1202.	424.	177.	21214.
CMS	50.	34.	12.	5.	601.
INCHES		12.71	17.94	18.69	18.69
MM		322.85	455.60	474.66	474.66
AC-FT		596.	841.	877.	877.
THOUS CU M		735.	1038.	1081.	1081.

1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	200	400.	600.	800.	1000.	1200.	1400.	1600.	1800.	0.	0	0
0 30	11												
1 00	21												
1 30	31												
2 00	41												
2 30	51												
3 00	61												
3 30	71												
4 00	81												
4 30	91												
5 00	101												
5 30	111												
6 00	121												
6 30	131												
7 00	141												
7 30	151												
8 00	161												
8 30	171												
9 00	181												

```
 9 30 19I
10 00 20I
10 30 21I
11 00 22I
11 30 23I
12 00 24I
12 30 25I
13 00 26I
13 30 27I
14 00 28I
14 30 29I
15 00 30I
15 30 31I
16 00 32I
16 30 33OI
17 00 34O  I
17 30 35O  I
18 00 36.O  I
18 30 37 O I
19 00 38.O I
19 30 39 OI
20 00 40 OI
20 30 41 I
21 00 42 I
21 30 43 I
22 00 44 I
22 30 45IO
23 00 46IO
23 30 47IO
 0 00 48IO
 0 30 49IO
 1 00 50IO
 1 30 51IO
 2 00 52IO
 2 30 53 I
 3 00 54 I
 3 30 55 I
 4 00 56 I
 4 30 57 I
 5 00 58 I
 5 30 59 I
 6 00 60 I
 6 30 61 I
 7 00 62 I
 7 30 63 OI
 8 00 64 O I
 8 30 65 O I
 9 00 66 O  I
 9 30 67 O  I
10 00 68  O  I
10 30 69  O  I
11 00 70  O  I
11 30 71  O  I
12 00 72   O I
12 30 73   O  I
13 00 74    O    I.
13 30 75      O      I
14 00 76        O        I
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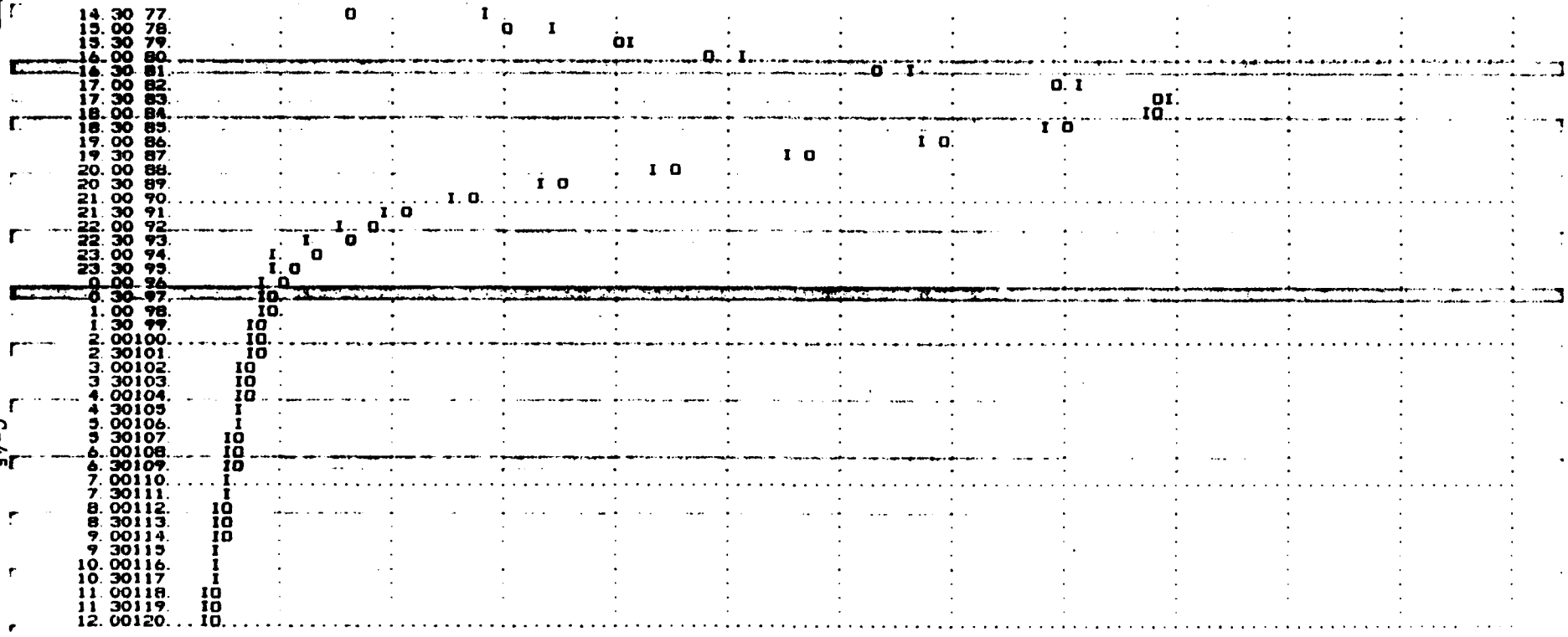


1*OVN*

STATION 1, PLAN 1, RATIO 8

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0	0	0	0	0	0	0	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	1	2	5	10	19	25	27	28	29

29.	29.	29.	28.	27.	27.	26.	25.	23.	21.
19.	18.	17.	17.	17.	17.	17.	17.	17.	18.
18.	19.	21	25	27.	29.	32.	34.	39.	47.
57.	69.	80.	103.	151.	248.	404.	788.	888.	1122.
1444	1803	2019.	2008.	1817.	1573.	1307.	1036.	797.	612.
475	378.	337.	293.	252.	225.	207.	194.	185.	178.
171.	164	157	151.	145.	139.	133.	128.	124.	120.
116.	112.	108.	103.	99.	96.	92.	88.	85.	82.

STORAGE

0	0	0	0	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	0	0	0.	0.	0.	0.	0.	0.	0.
0.	1	1.	3.	6.	8.	11.	12.	14.	14.
15.	14.	14.	13.	13.	12.	11.	10.	10.	9.
9.	8.	8.	8.	8.	8.	8.	8.	8.	8.
8.	9.	9.	10.	12.	14.	17.	20.	23.	25.
28.	30.	32.	35.	40.	48.	57.	62.	63.	65.
67.	70.	71.	71.	70.	68.	66.	64.	62.	60.
58.	57.	55.	51.	48.	47.	45.	44.	44.	43.
42.	42.	41.	40.	40.	39.	39.	38.	38.	37.
37.	36.	36.	35.	35.	34.	34.	33.	33.	32.

STAGE

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.1	110.1	110.3	110.5	110.8	111.0	111.2	111.3	111.4
111.4	111.4	111.3	111.3	111.2	111.2	111.1	111.0	110.9	110.9
110.8	110.8	110.8	110.7	110.7	110.7	110.8	110.8	110.8	110.8
110.8	110.8	110.9	111.0	111.2	111.4	111.6	111.9	112.1	112.4
112.6	112.8	113.0	113.2	113.7	114.3	115.1	115.4	115.5	115.7
115.9	116.1	116.2	116.2	116.1	115.9	115.8	115.6	115.4	115.3
115.2	115.0	114.8	114.6	114.3	114.2	114.1	114.0	113.9	113.9
113.8	113.8	113.7	113.7	113.6	113.6	113.5	113.5	113.5	113.4
113.4	113.3	113.3	113.2	113.2	113.1	113.1	113.1	113.0	113.0

PEAK OUTFLOW IS 2019. AT TIME 41.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2019.	1376.	486.	203.	24316.
CMS	57.	39.	14.	6.	689.
INCHES		14.55	20.55	21.42	21.42
MM		369.49	522.03	544.07	544.07
AC-FT		682.	964.	1005.	1005.
THOUS CU M		842.	1189.	1239.	1239.

1*OVF*

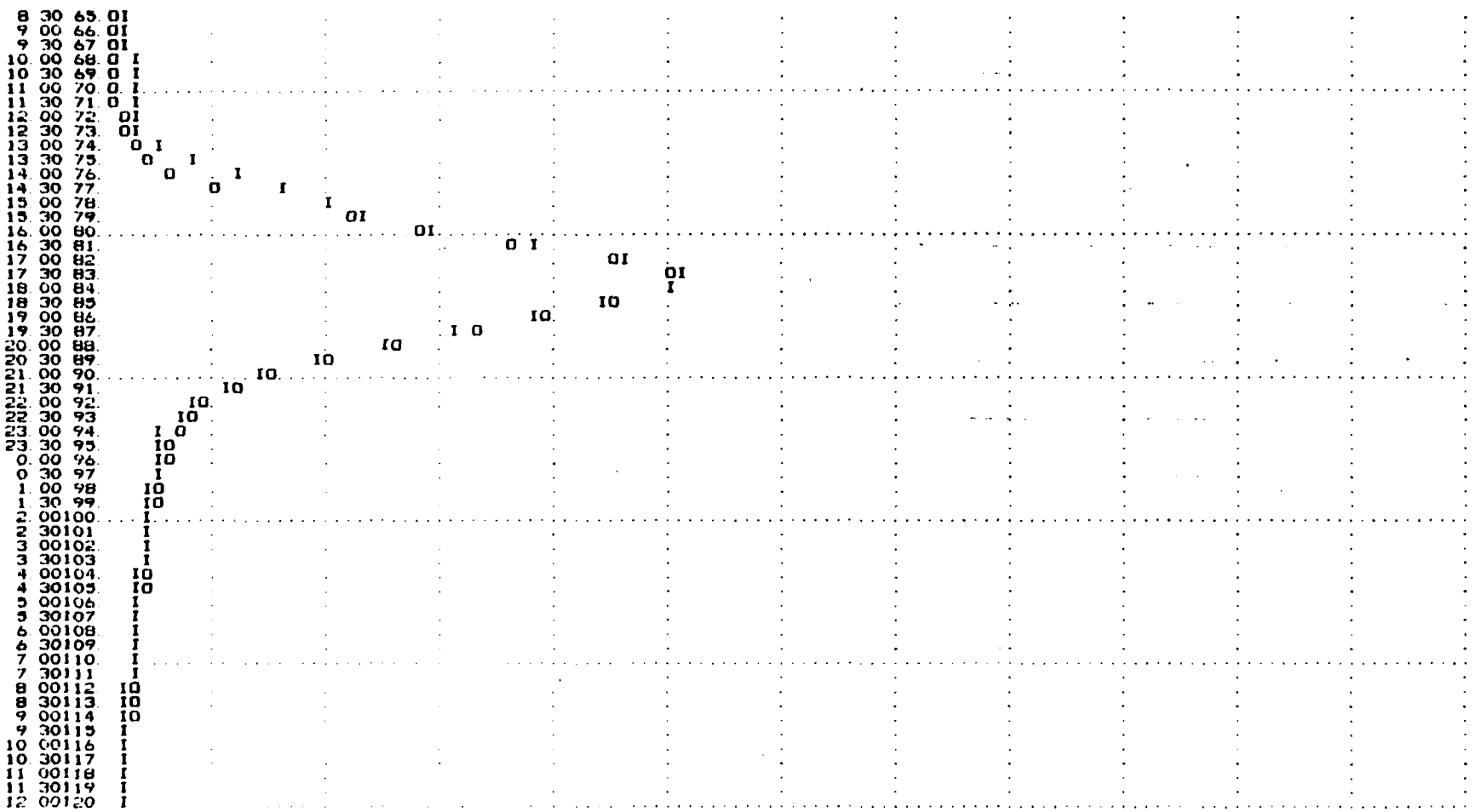
STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0 400 800 1200 1600 2000 2400 0. 0. 0. 0. 0. 0.

0	30	1I	.	.	.	.	.	.	.	.	.	.	.	.
1	00	2I	.	.	.	.	.	.	.	.	.	.	.	.
1	30	3I	.	.	.	.	.	.	.	.	.	.	.	.
2	00	4I	.	.	.	.	.	.	.	.	.	.	.	.
2	30	5I	.	.	.	.	.	.	.	.	.	.	.	.
3	00	6I	.	.	.	.	.	.	.	.	.	.	.	.

3.30 7I
4.00 8I
4.30 9I
5.00 10I
5.30 11I
6.00 12I
6.30 13I
7.00 14I
7.30 15I
8.00 16I
8.30 17I
9.00 18I
9.30 19I
10.00 20I
10.30 21I
11.00 22I
11.30 23I
12.00 24I
12.30 25I
13.00 26I
13.30 27I
14.00 28I
14.30 29I
15.00 30I
15.30 31I
16.00 32I
16.30 3301
17.00 3401
17.30 350 I
18.00 360 I
18.30 37 01
19.00 38.01
19.30 39. I
20.00 40. I
20.30 41. I
21.00 42. I
21.30 4310
22.00 4410
22.30 4510
23.00 4610
23.30 4710
0.00 4810
0.30 4910
1.00 5010
1.30 511
2.00 521
2.30 531
3.00 541
3.30 551
4.00 561
4.30 571
5.00 581
5.30 5901
6.00 6001
6.30 6101
7.00 6201
7.30 63 I
8.00 64.01


8 30 65 OI
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13 30 75 O I
14 00 76 O I
14 30 77 O I
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16 30 81 O I
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17 30 83 OI
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2 00100 I
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3 30103 I
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4 30105 IO
5 00106 I
5 30107 I
6 00108 I
6 30109 I
7 00110 I
7 30111 I
8 00112 IO
8 30113 IO
9 00114 IO
9 30115 I
10 00116 I
10 30117 I
11 00118 I
11 30119 I
12 00120 I

1*DVN*

STATION 1, PLAN 1, RATIO 9

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	3.	6.	14.	25.	28.	30.	32.	33.
33.	33.	33.	32.	32.	31.	30.	29.	28.	28.
27.	26.	26.	25.	25.	24.	24.	24.	24.	24.
25	25.	26.	28.	30.	33.	37.	46.	59.	75.
91.	106.	120.	149.	214.	337.	710.	949.	1129.	1401.
1814.	2298.	2527.	2508.	2268.	1962.	1629.	1289.	991.	758.
587.	460.	371.	335.	299.	273.	254.	240	228.	218.
208.	200	192.	185.	179.	173.	166.	160	154.	148.
142.	136.	131.	126.	122.	118.	114.	110.	105.	101.

STORAGE

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	2.	4.	7.	10.	13.	16.	17.	18.
19.	19.	18.	18.	17.	16.	15.	14.	14.	13.
12.	11.	11.	11.	10.	10.	10.	10.	10.	10.
10	11.	11.	13.	15.	18.	22.	25	28.	31.
34.	35.	37.	40.	46.	55.	61.	63	65.	67.
70	73.	74.	74.	73.	71.	69	66.	64.	62
60.	58.	57.	54.	52.	50.	49.	48.	47.	46.
45.	45	44.	44.	43.	42.	42.	41.	41.	40.
40.	39.	39.	38.	37.	37.	36.	36.	35.	35.

STAGE

110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110 0	110 0	110 0
110.0	110.0	110.0	110.0	110.0	110.0	110.0	110 0	110 0	110 0
110.0	110.1	110.2	110.4	110.7	111.0	111.3	111.5	111.6	111.7
111.8	111 8	111.7	111.7	111.6	111.5	111.5	111 4	111.3	111.2
111.2	111.1	111.0	111.0	111.0	111.0	111.0	111 0	111.0	111.0
111 0	111 0	111.1	111 2	111.5	111.7	112 0	112 3	112 6	112 9
113.1	113.3	113.4	113.7	114.1	114.8	115.4	115.6	115 7	115.8
116 1	116.3	116.4	116 4	116 3	116.1	116.0	115 8	115 6	115.4
115.3	115.1	115.0	114.8	114.6	114.5	114.4	114.3	114.2	114 1
114.1	114 0	114.0	113.9	113 9	113.8	113 8	113 7	113 7	113.6
113.6	113.6	113.5	113.5	113.4	113.4	113.3	113.3	113.2	113.2

PEAK OUTFLOW IS 2527. AT TIME 41.50 HOURS

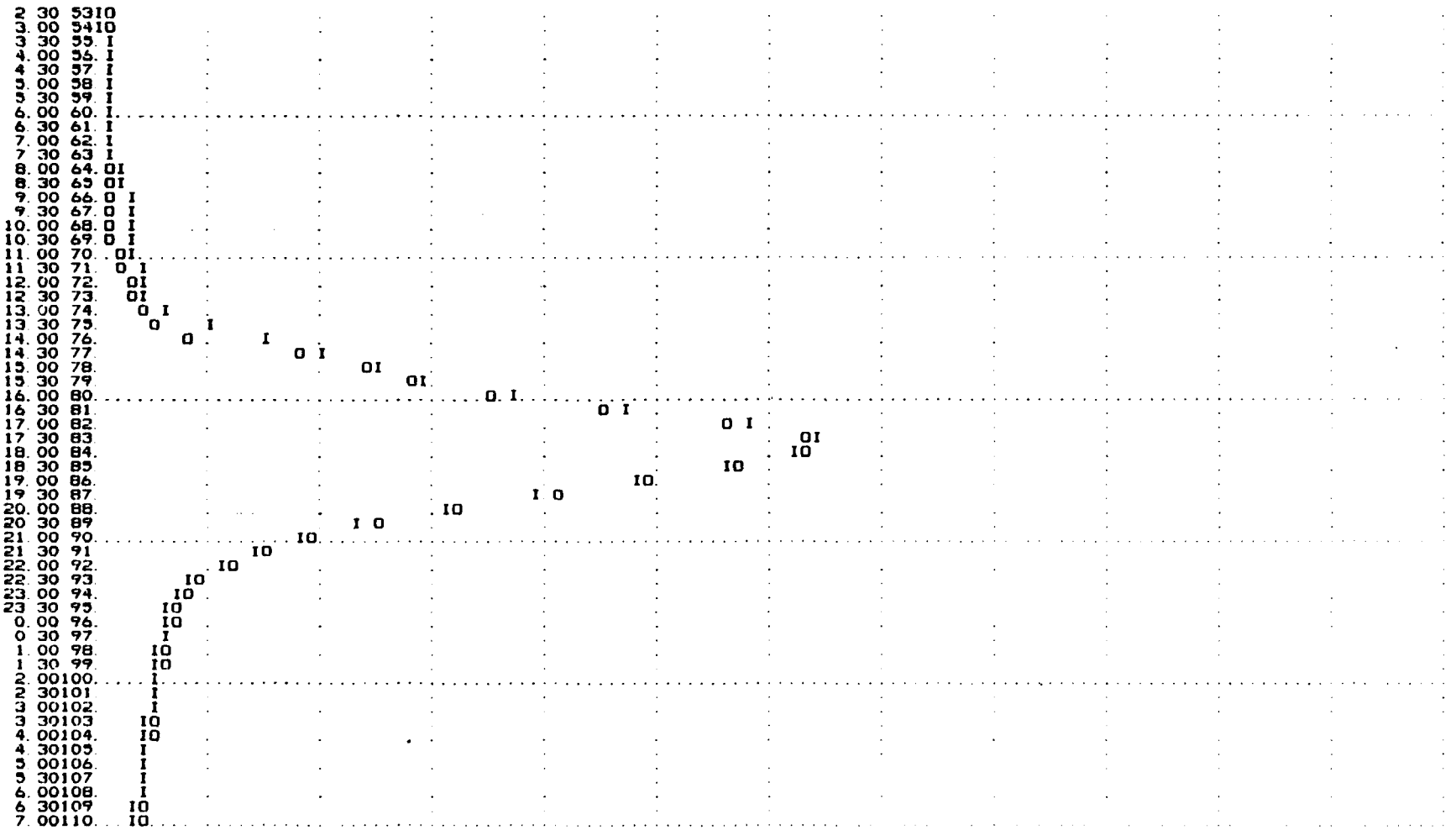
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2527	1719.	609.	254.	30530.
CMS	72.	49.	17.	7.	865.
INCHES		18 17	25 77	26 89	26 89
MM		461.59	654.47	683.12	683.12
AC-FT		852	1209.	1262	1262
THOUS CU M		1051.	1491.	1556.	1556

1*OVF*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	400.	800.	1200.	1600.	2000.	2400.	2800.	0.	0.	0.	0.	0.
0 30	11												
1 00	21												
1 30	31												
2 00	41												
2 30	51												
3 00	61												
3 30	71												
4 00	81												
4 30	91												
5 00	101												
5 30	111												
6 00	121												
6 30	131												
7 00	141												
7 30	151												
8 00	161												
8 30	171												
9 00	181												
9 30	191												
10 00	201												
10 30	211												
11 00	221												
11 30	231												
12 00	241												
12 30	251												
13 00	261												
13 30	271												
14 00	281												
14 30	291												
15 00	301												
15 30	311												
16 00	321												
16 30	3301												
17 00	340 I												
17 30	350 I												
18 00	36. 0 I												
18 30	37. 0I												
19 00	38. 0I												
19 30	39. 0I												
20 00	40 I												
20 30	41 I												
21 00	42 I												
21 30	43 I												
22 00	4410												
22 30	4510												
23 00	4610												
23 30	4710												
0 00	4810												
0 30	4910												
1 00	5010												
1 30	5110												
2 00	5210												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8 00 64 OI
8 30 65 OI
9 00 66 O I
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10 30 69 O I
11 00 70 OI
11 30 71 O I
12 00 72 OI
12 30 73 OI
13 00 74 O I
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22 00 92 IO
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23 00 94 IO
23 30 95 IO
0 00 96 IO
0 30 97 I
1 00 98 IO
1 30 99 IO
2 00100 I
2 30101 I
3 00102 I
3 30103 IO
4 00104 IO
4 30105 I
5 00106 I
5 30107 I
6 00108 I
6 30109 IO
7 00110 IO

```
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  8 00112    I
  8 30113    I
  9 00114    I
  9 30115    I
 10 00116    I
 10 30117    I
 11 00118   IO
 11 30119   IO
 12 00120   IO
```

1*DVN*

1 ********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 0.10	RATIO 2 0.20	RATIO 3 0.30	RATIO 4 0.40	RATIO 5 0.50	RATIO 6 0.60	RATIO 7 0.70	RATIO 8 0.80	RATIO 9 1.00
				RATIOS APPLIED TO FLOWS								
HYDROGRAPH AT	1	0.88	1	255.	510.	764.	1019.	1274.	1529.	1783.	2038.	2548.
		(2.28)		(7.21)(	14.43)(	21.64)(	28.86)(	36.07)(	43.28)(	50.50)(	57.71)(	72.14)
ROUTED TO	1	0.88	1	197.	520.	758.	1009.	1258.	1514.	1767.	2019.	2527.
		(2.28)		(5.57)(	14.73)(	21.45)(	28.58)(	35.62)(	42.87)(	50.04)(	57.18)(	71.55)

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	110.00	112.00	115.00
STORAGE	0.	21.	56.
OUTFLOW	0.	36.	365.

RATIO OF PMF	MAXIMUM RESERVOIR W S ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	114.03	0.00	45.	197.	0.00	43.00	0.00
0.20	115.21	0.21	59.	520.	2.00	42.00	0.00
0.30	115.41	0.41	62.	758.	4.00	42.00	0.00
0.40	115.59	0.59	64.	1009.	5.00	41.50	0.00
0.50	115.75	0.75	66.	1258.	6.00	41.50	0.00
0.60	115.90	0.90	68.	1514.	7.00	41.50	0.00
0.70	116.04	1.04	70.	1767.	7.00	41.50	0.00
0.80	116.17	1.17	71.	2019.	8.00	41.50	0.00
1.00	116.42	1.42	74.	2527.	8.50	41.50	0.00

1**********

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

APPENDIX D

PREVIOUS INSPECTION REPORTS/AVAILABLE DOCUMENTS

PREVIOUS INSPECTION REPORTS

STATE OF NEW YORK
DEPARTMENT OF PUBLIC WORKS

J. BURCH McMORRAN
SUPERINTENDENT

JOSEPH C. FEDERICK, DIST. ENG.
71 FREDERICK STREET, BINGHAMTON, N. Y. 13902

COUNTIES IN 9TH DISTRICT
BROOME
CHENANGO
DELAWARE
OTSEGO
SCHOHARIE
SULLIVAN

BINGHAMTON, N.Y.,

May 5, 1967

RE: Dam 146-3568
Town of Andes
County of Delaware
Robert Bishop, Owner

Mr. J. R. Stellato, Acting Ass't. Supt.
Division of Operation & Maintenance (Canals)
New York State Department of Public Works
State Campus, 1220 Washington Avenue
Albany, New York

ATTENTION: Mr. E. Rowan

Dear Sir:

On April 20, 1967 Mr. C. DeJean and our photographer, Mr. Gerald Whalen, inspected the construction of the above mentioned dam; and Mr. DeJean makes the following report.

The dam appears to be well constructed of suitable material and about 90 per cent complete. The work still to be performed is as follows:

1. Distribute gravel over the top of the dam and compact it. The gravel is now wind-rowed on top of the dam and appears in Photos 30-4, 30-5, 30-6, and 30-7.

2. Place grouted rip-rap in the emergency spillway.

3. Place grouted rip-rap at the outlet of the trickle tube.

4. Fine grade the down stream side of the dam and also the stilling basin and the outlet of the emergency spillway.

The only deviation to date from the approved plans was the construction of the emergency spillway on the east side of the dam at the approved elevation instead of on the west side.

This is the end of Mr. DeJean's report.

We are enclosing nine photos of the construction.

Very truly yours,

Joseph C. Federick Co
JOSEPH C. FEDERICK
District Engineer

CLD:esg
Enclosures

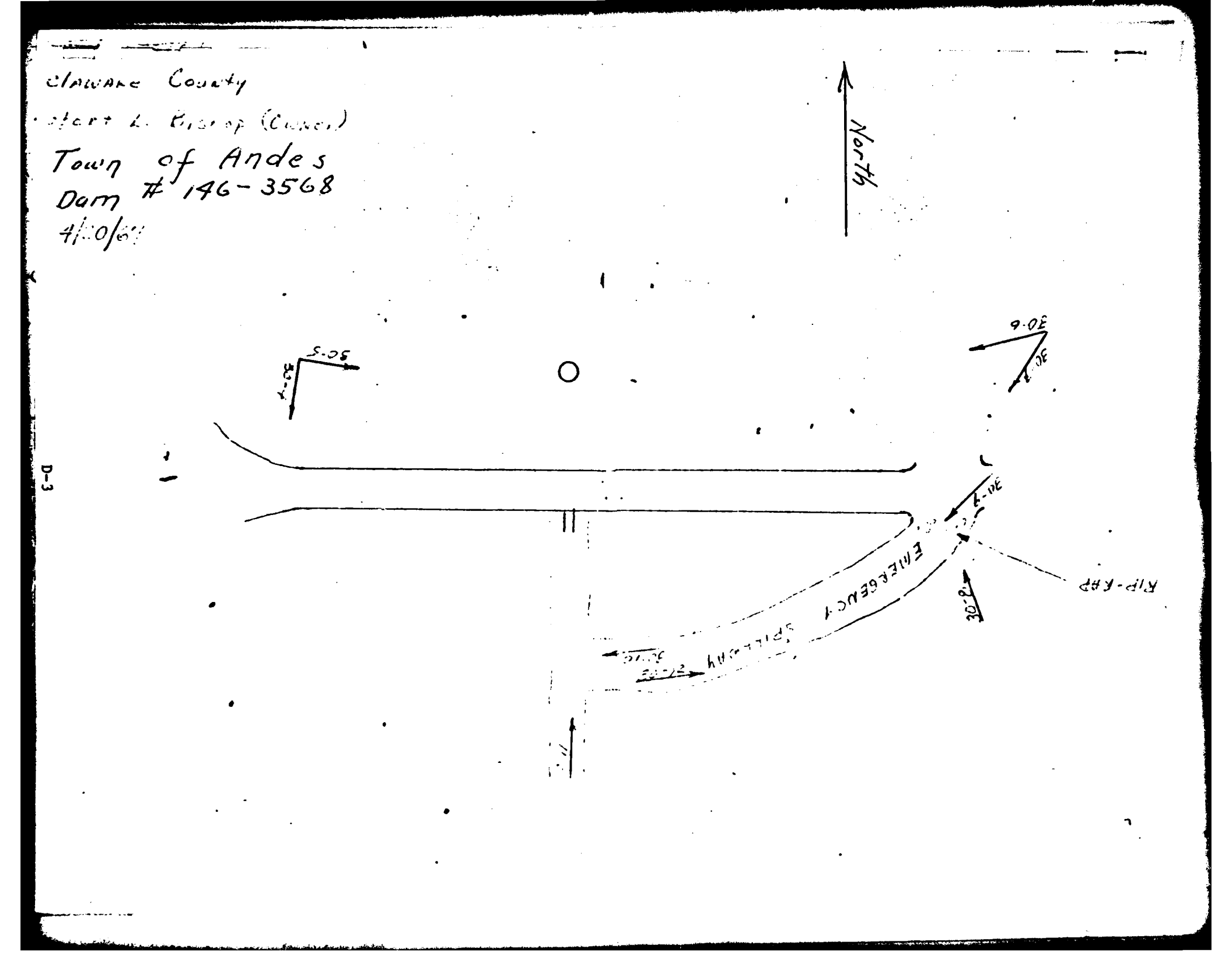
Delaware County

Albert L. Bishop (Owner)

Town of Andes

Dam # 146-3568

4/20/64



D-3

PHOTO #30-4

PHOTO #30-5

PHOTO #30-6

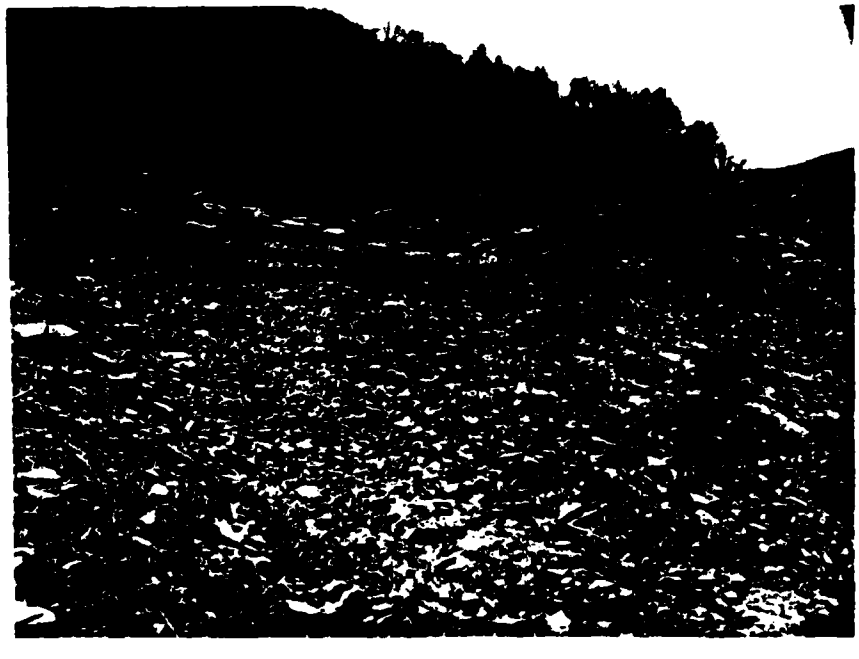


PHOTO #30-7

PHOTO #30-8

PHOTO #30-9

PHOTO #30-10

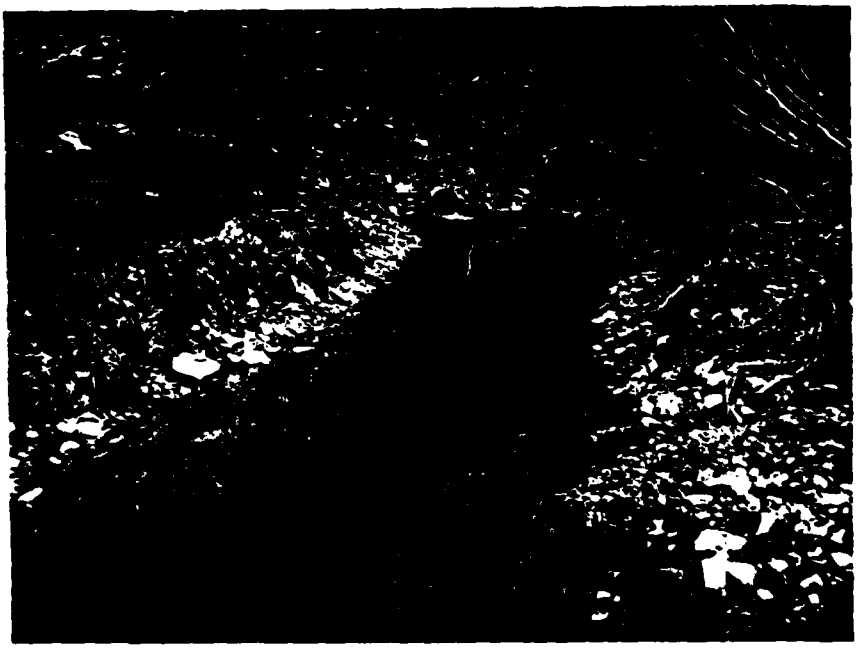


PHOTO #30-11

PHOTO #30-12

STATE OF NEW YORK

DEPARTMENT OF PUBLIC WORKS

J. BURCH McMORRAN
SUPERINTENDENT

JOSEPH C. FEDERICK, DIST. ENG.
71 FREDERICK STREET, BINGHAMTON, N.Y. 13902

COUNTIES IN 9TH DISTRICT
BROOME
CHENANGO
DELAWARE
OTSEGO
SCHOHARIE
SULLIVAN

RECEIVED
ASST. SUPT.
OPER. AND MAINT.
WAT[illegible] SUBDIVISION
[illegible] 28 1967
Ref[illegible]
[illegible]
[illegible]construction
[illegible]
[illegible]
[illegible] Traffic
Sh[illegible] & Floating Plant
Canal Permits
Head Clerk
File

RE: Dam # 146-3568
Town of Andes
Delaware County
Robert Bishop - Owner

BINGHAMTON, N.Y.,

July 26, 1967

Mr. J. R. Stallato
Acting Asst. Supt. of Operations & Maintenance (Canals)
New York State Dept. of Public Works
State Campus
1220 Washington Ave.
Albany, New York

ATTENTION: Mr. E. Rowan

Dear Sir:

We are enclosing nine photos taken on July 11, 1967 by Mr. Gerald Whalen of the above noted dam. Mr. DeJean made an inspection of the dam on July 25, 1967 and makes the following report.

The dam appears to be well constructed with satisfactory material according to the approved plans with the following exceptions.

The emergency spillway was constructed on the east side of the dam instead of on the west side. It discharges into the brook about 50 feet down stream from the outlet end of the trickle tube.

Additional clean up work should be done at the outlet end of the trickle tube and the grouted rip-rap should be placed that is called for in the plans.

The emergency spillway varies in width from 12 to 16 feet instead of the 20 feet called for in the plans. The stone rip-rap should be continued through the section of spillway that passes through the top section of the dam and this section should be grouted. The last section of spillway as it enters the stream is on a steep grade and should be rip-raped as erosion has already started. There is approxemately 20 feet in this section. * See Back.

It would appear that the board walk to the water control sluice gate would not be built. However, a boat is available and a ladder has been installed to the platform on which the operating mechanism is installed.

The top of the dam and down stream slope has been seeded and the growth is now well started.

This was the end of Mr. DeJeans report.

Very truly yours,

Joseph C. Federick

JOSEPH C. FEDERICK Dist. Engr.

CLD:wfp

THINK HIGHWAY SAFETY THINK HIGHWAY SAFETY THINK HIGHWAY SAFETY
THINK HIGHWAY SAFETY THINK HIGHWAY SAFETY THINK HIGHWAY SAFETY

Town of Andes

Delaware County

Robert L Bishop (Owner)

7-11-67

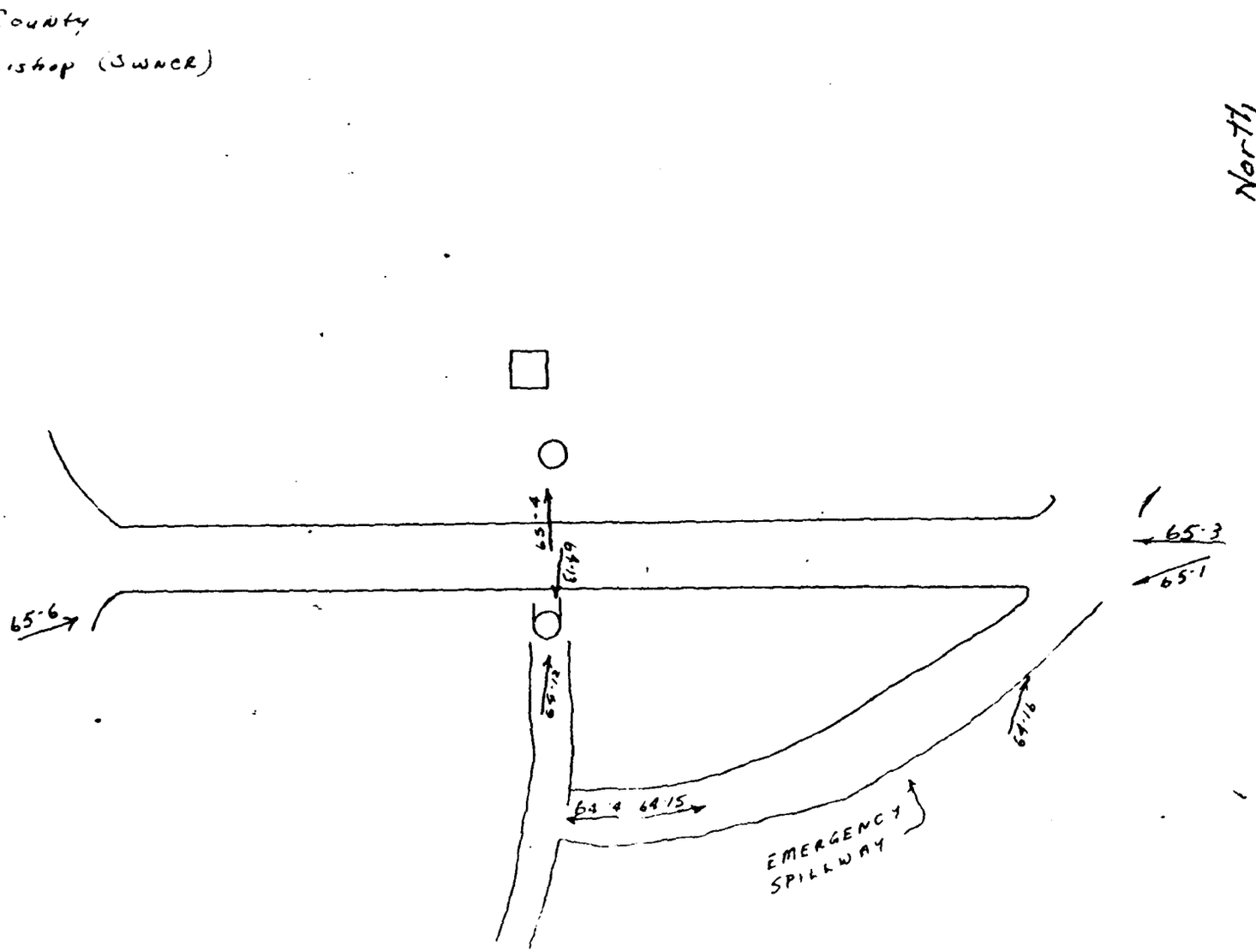


PHOTO #65-1

PHOTO #65-3

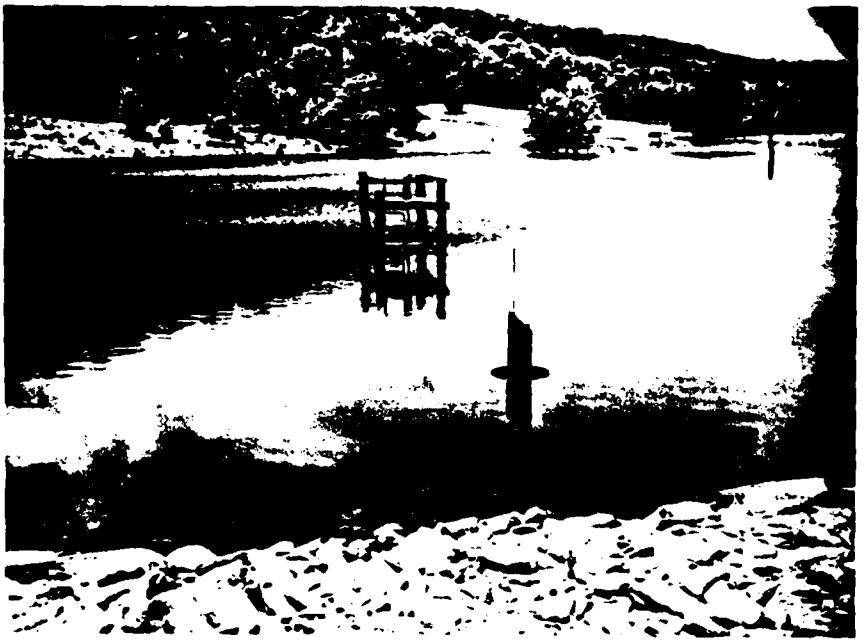


PHOTO #65-4

PHOTO #65-6

PHOTO #64-12

PHOTO #64-13

PHOTO #64-14

PHOTO #64-15

PHOTO #64-16

DAM CONSTRUCTION PERMIT APPLICATION

STATE OF NEW YORK
WATER RESOURCES COMMISSION
CONSERVATION DEPARTMENT
ALBANY, N.Y. 12226

WRC FORM #2 1/66

Do Not Write in This Box

Appl. No. 7D-36-66
Permit No. _____

Dam No. 146-3568
Watershed ~~7D-36-66~~ Delaware River

Application for a Permit for the Construction, Reconstruction or Repair of a Dam or Other Impoundment Structure under Conservation Law, Section 429(c).

INSTRUCTIONS

1. Type or print in ink.
2. All papers must be filed in quadruplicate.
3. The completed application relating to construction, reconstruction or repair of a dam must include the following information:

   (a) A topographical plan (with contours) of the impounded area drawn to a suitable scale.

   (b) A profile and transverse section of the impounded area showing the proposed excavation, the normal water and possible high water elevations. A 1'-0" minimum of freeboard is to be provided between the top of the dam and the possible high water.

   (c) A longitudinal elevation and transverse section of the dam with all the necessary details of the related appurtenances, spillways, drains, etc.

   (d) A log of the soil information. Samples of the materials to be used in the dam and of the material upon which the dam is to be founded may be asked for, but need not be furnished unless requested.
4. No work of construction, reconstruction or repairs of the structure or structures shall be started until a permit therefor has been issued by the New York State Water Resources Commission.
5. The design, preparation of plans, estimates and specifications and the supervision of the erection, reconstruction and repair of all the structures herein applied for shall be done by a licensed professional engineer, or in the case of farm ponds by an engineer or conservationist employed by a governmental agency cooperating with a soil conservation district, or by an engineer employed by the Conservation Department.
6. A "Notice of Application" must be published by the applicant. The form of notice and instructions for publication will be furnished to the applicant by the Local Permit Agent to whom the application is delivered.

APPLICATION

Application is hereby made by Lucille S. and Robert L. Bishop
to the Conservation Department acting on behalf of the Water Resources Commission, pursuant to the provisions of Conservation Law, Section 429(c) for a permit to (construct) ([redacted]) ([redacted]) a dam or impoundment structure substantially as shown on plans and specifications marked Dam & Lake for Robert L. Bishop herewith submitted and described.

It is intended to commence the work covered by the application about August 1, 1966 (Date) and complete it about October 1, 1966 (Date).

1. The dam will be on Clove Hollow Brook flowing into Fall Clove
in the town of Andes County of Delaware and

(Give exact distance and direction from a well-known bridge, dam, village, main cross-roads or mouth of a stream)

2. Location of dam is shown on the attached map or overlay of the Andes quadrangle of the United States Geological Survey at latitude N 42° 10' 10" longitude W 74° 51' 53".

3. The impounded water will be used for recreation

4. Will any part of the dam be built upon or its pond flood any State lands? No

5. The area draining into the proposed pond or lake is 565 acres; 0.88 square miles.

6. The computed 50 year peak rate of runoff used in the design is 288 cu. ft. per sec. State criterion or method used in determining the peak rate of runoff rational formula c=0.30 i=250/t+27 (50 year frequency)

7. The maximum height of the proposed dam above the bed of the stream will be 33 feet 0 inches.

8. The designed maximum high water elevation above the spillcrest is computed to be 1 feet 6 inches; the designed freeboard as measured from the maximum high water elevation to the top of the proposed dam will be 1 feet 6 inches. (One foot minimum)

9. The open spillway of the proposed dam that will control the designed flood flow will be of vegetated earth

(State type, such as: vegetated earth, concrete, masonry, timber, rock filled crib, etc.)

The width of the control section of the spillway, measured normal to the flow of water at the crest, will be 20 feet 0 inches in the clear; facing down stream, the waters will be held at the right end by a cut bank the top of which will be - feet - inches above the spillcrest, and have a top width of - feet - inches; and at the left end by a riprapped bank of dam the top of which will be 3 feet 0 inches above the spillcrest and have a top width of 20 feet 0 inches. The slope of the sides of the spillway will be 1 ft. vert. on 3 ft. horiz. (left) 1 ft. vert. on 3 ft. horiz. (right).

10. The spillway is designed to safely discharge 233 cu. ft. per sec.

11. The surface area of the proposed pond or lake will be 10.1 acres at the normal water elevation and 11.1 acres at the spillcrest elevation; the volume of the water impounded in the pond or lake will be 31.7 m.g. gallons at the normal water elevation and 38.6 m.gallons at the spillcrest elevation.

12. The normal water elevation of the proposed pond or lake will be 2 feet 0 inches below the spillway crest, and will be maintained by means of a trickle tube; the pond or lake will be drained by means of a slide gate; provision will be made for supplying water to riparian owners downstream, during dry seasons, by means of a slide gate.

13. The maximum discharge through the spillway that controls the normal water elevation will be 54.8 cu. ft. per sec. during maximum high water.

14. If flashboards are to be used to control flood flow they must be of the automatic or self-tilting type, designed to fail or otherwise permit full discharge through the spillway when the flood waters reach a height of - feet - inches above the spillcrest.

15. If an overfall structure is used as a spillway, it shall be provided with an apron constructed of - ; the thickness of the - will be - feet - inches, the width - feet - inches across the stream and the length - feet - inches parallel to the stream.

16. Facing downstream, what is the nature of material composing the right bank? clay & hard pan

17. Facing downstream, what is the nature of the material composing the left bank? clay & hard pan

18. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) clay & sand mixtures

19. *Are there any porous seams or fissures beneath the foundation of the proposed dam?* Yes. This will be sealed by cork wall & clay mantle wherever exposed during excavation.

20. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. The character of the bed and banks is hard impervious hardpan & clay.

21. Was the above soil information obtained from soil borings? ; test pits? X

22. State the height above the spillcrest elevation of the lowest part of the immediate upstream adjoining property or properties, - 7 feet 0 inches. Flooding easements have been obtained, copy attached.

23. Does this proposed pond or lake constitute any part of a public water supply? no If not, where is the nearest downstream public water supply intake located? Downsville Dam on Papacton Reservoir

24. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam none

25. The design, plans and specifications have been prepared under the supervision of S. Lawrence Baldwin
(Authorized Agency) or P.E. License No. 36732

Address Baldwin-Kalmus Associates 418 Chestnut St. Oneonta, NY Title Partner

26. The erection will be under the supervision of
(State which: Erection, Reconstruction or Repairs)
(Authorized Agency) or P.E. License No.

Address Baldwin-Kalmus Associates Title

27. Name and address of official newspaper of the town or city in which the proposed works are to be located,
Delaware Republican Express, Delhi
Attn: Henry Hovemeyer, Editor

All provisions of law will be complied with in the erection and maintenance of the proposed dam or impoundment structure. The construction will be carried out substantially in accordance with the approved plans and specifications.

If the applicant is other than the owner, the applicant certifies that he has been duly authorized by the owner to make the application and to carry out the project described herein.

The applicant certifies the truth of the above statements and agrees that the issuance of the permit is based on the accuracy thereof. As a condition to the issuance of a permit, the applicant accepts full legal responsibility for all damage, direct or indirect, of whatever nature, and by whomever suffered, arising out of the project described herein and agrees to indemnify and save harmless the State from suits, actions, damages and costs of every name and description resulting from the said project.

Lucille S. Bishop &
Robert L. Bishop, Owners

By , authorized agent of owner.

Address of owner Dr Lancey, NY

Address of signer Date
(If other than owner)

NOTE: Acceptance of a permit subjects permittee to restrictions, regulations or obligations stated in application and permit.

APPENDIX E

REFERENCES

REFERENCES

1. Chow, Ven Te, Editor - Handbook of Applied Hydrology. McGraw-Hill Book Company, New York, New York, 1964.

2. Hydrologic Engineering Center, U.S. Army Corps of Engineers, HEC-1 Flood Hydrograph Package, Users Manual. Davis, California, January 1973.

3. Hydrologic Engineering Center, U.S. Army Corps of Engineers, Flood Hydrograph Package (HEC-1), Users Manual for Dam Safety Investigations, Davis, California, September 1978.

4. King, Horace and Brater, Ernest. Handbook of Hydraulics, 5th Edition. McGraw-Hill Book Company, New York, New York, 1963.

5. Riedel, J.T., Appleby, J.F. and Schloemer, R.W. Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours (Hydrometeorological Report No. 33) U.S. Department of Commerce - *Weather Bureau and U.S. Department of the Army - Corps of Engineers*, Washington, D.C., April 1956

6. U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, Second Edition, Washington, D.C., 1973.

APPENDIX F

DRAWINGS

DAM AND LAKE FOR ROBERT

TOWN OF ANDES, COUNTY OF DELAWARE, STATE

SCALE: AS INDICATED

BALDWIN-KALMUS ASSOCIATES ONEONT

S. LAWRENCE BALDWIN

146-356 D

HYDRAULIC DATA

TYPE	EARTH
LOCATION	LAT. 42°10' LONG. 74°52'
QUADRANGLE	ANDES
DAM HEIGHT	33 FT.
VOLUME	31.7 M.G. @ EL. 110
VOLUME	38.6 M.G. @ EL. 112
AREA	101 ACRES @ EL. 110
AREA	111 ACRES @ EL. 112
DRAINAGE AREA	565 ACRES
DRAINAGE AREA	0.88 SQUARE MILES

OR ROBERT L. BISHOP

OF DELAWARE, STATE OF NEW YORK

JUNE, 1966

TES ONEONTA, NEW YORK

P.E. 36732

146-365 DEL

RAULIC DATA

WOODS	40%
PASTURE	50%
BRUSHY	10%
QUANTITY OF FLOW	192.4 C.F.S. MAX.
EMERGENCY SPILLWAY	SOD AND RIP RAP
EMERGENCY SPILLWAY	36.7 S.F. WATERWAY
EMERGENCY SPILLWAY	148.9 C.F.S. @ EL. 1135
MECHANICAL SPILLWAY	54.5 C.F.S. @ EL. 1135
FREEBOARD	1.5 FEET
RAINFALL FREQUENCY	50 YEARS

STATE OF NEW YORK
DEPARTMENT OF PUBLIC WORKS
SUBDIVISION OF WATERWAY OPERATION
AND MAINTENANCE
ALBANY, N. Y. 12226

DESIGNATION NO. 146-3568

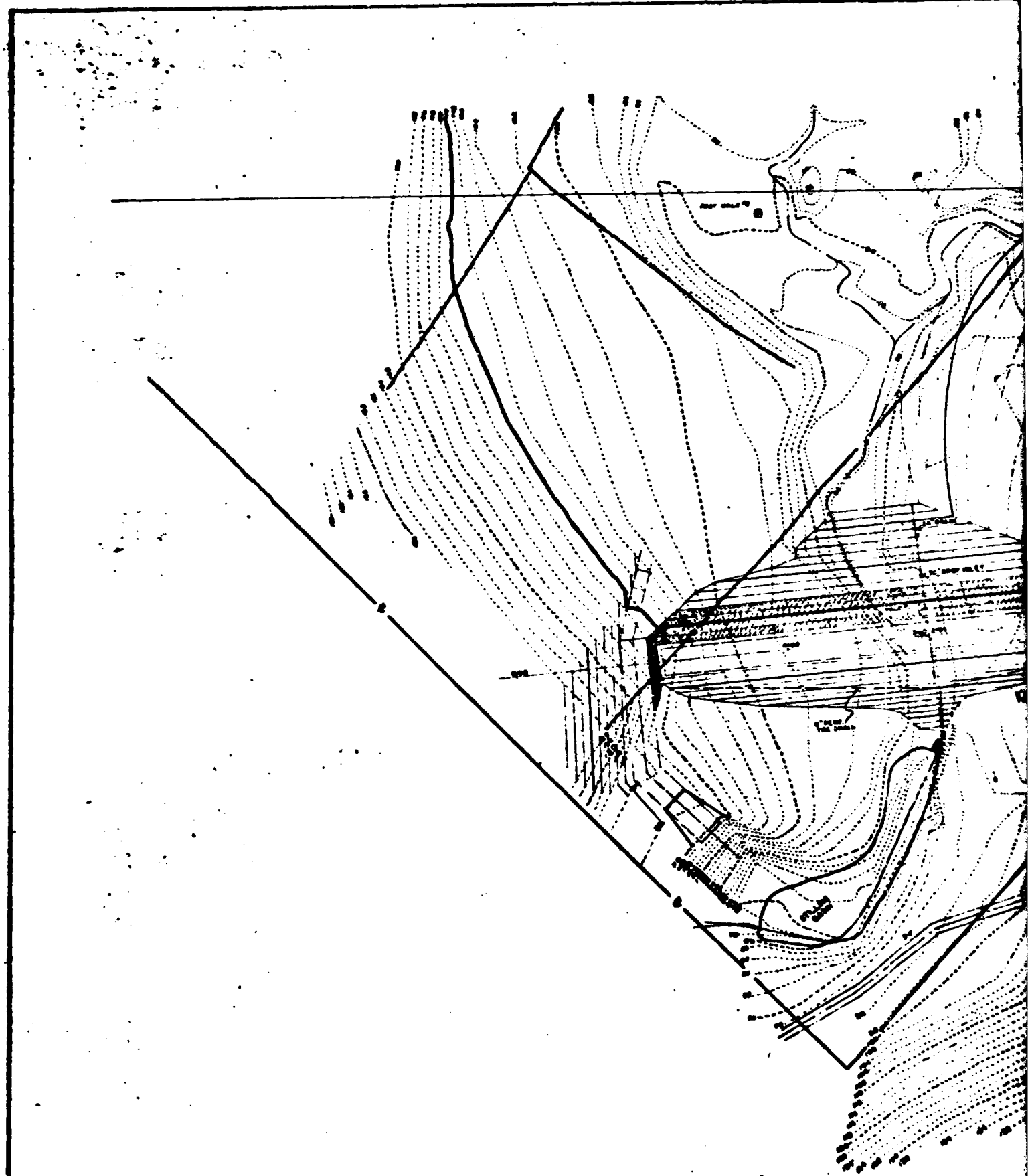
DATE RECEIVED [illegible]

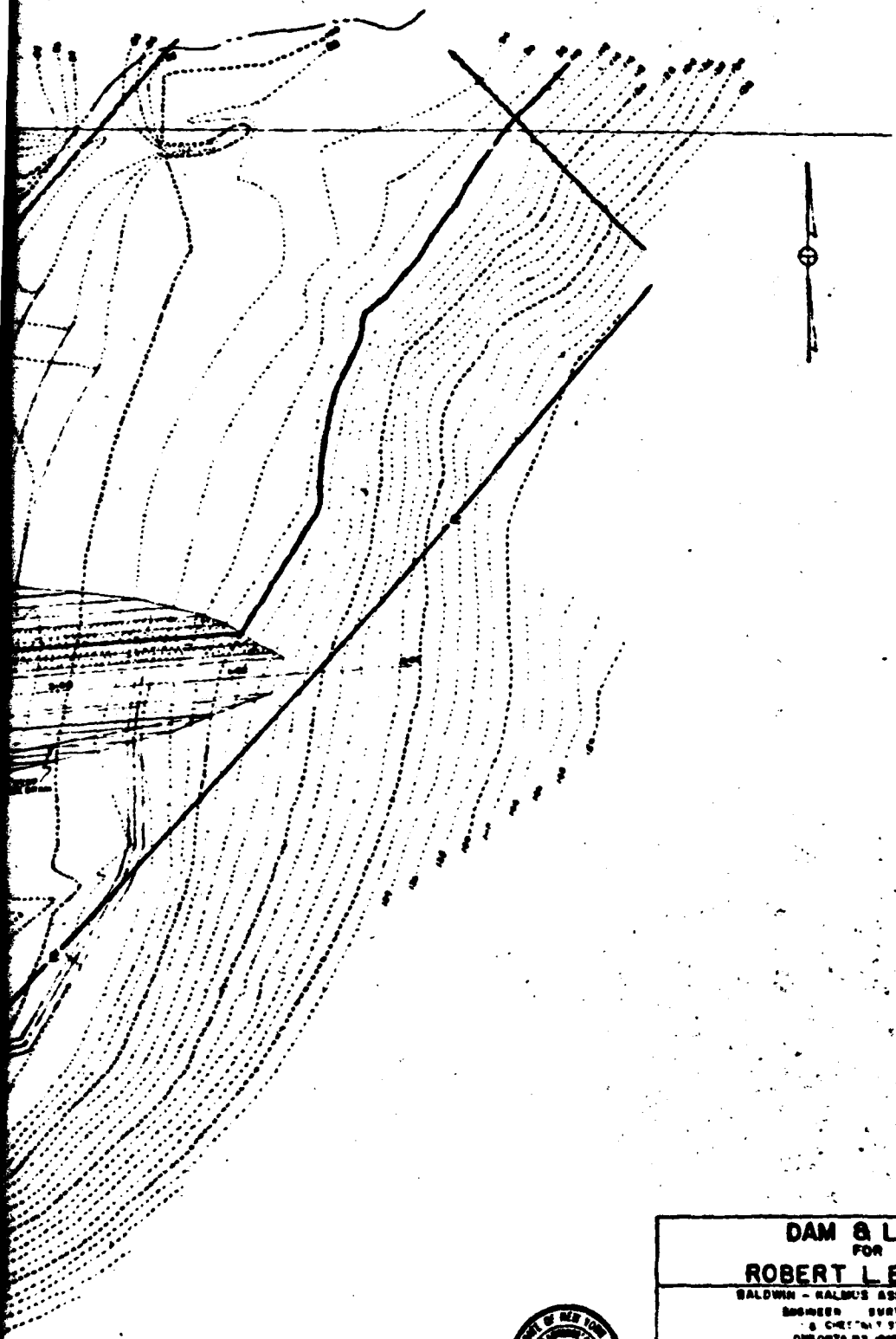
Pursuant to the provisions of Section 47(2) of the Conservation Law, the design, details and specifications for the construction of the structure shown on these plans are hereby approved. Date August 17, 1966

Reviewed by [signature] Senior Civil Engineer

APPROVED by [signature] Assistant Supervisor

12





DAM & LAKE
FOR
ROBERT L BISHOP

BALDWIN - KALBUS ASSOCIATES
ENGINEER SURVEYOR
8 CHESTNUT ST
ONEONTA, N.Y. 13820

TOPOGRAPHIC PLAN

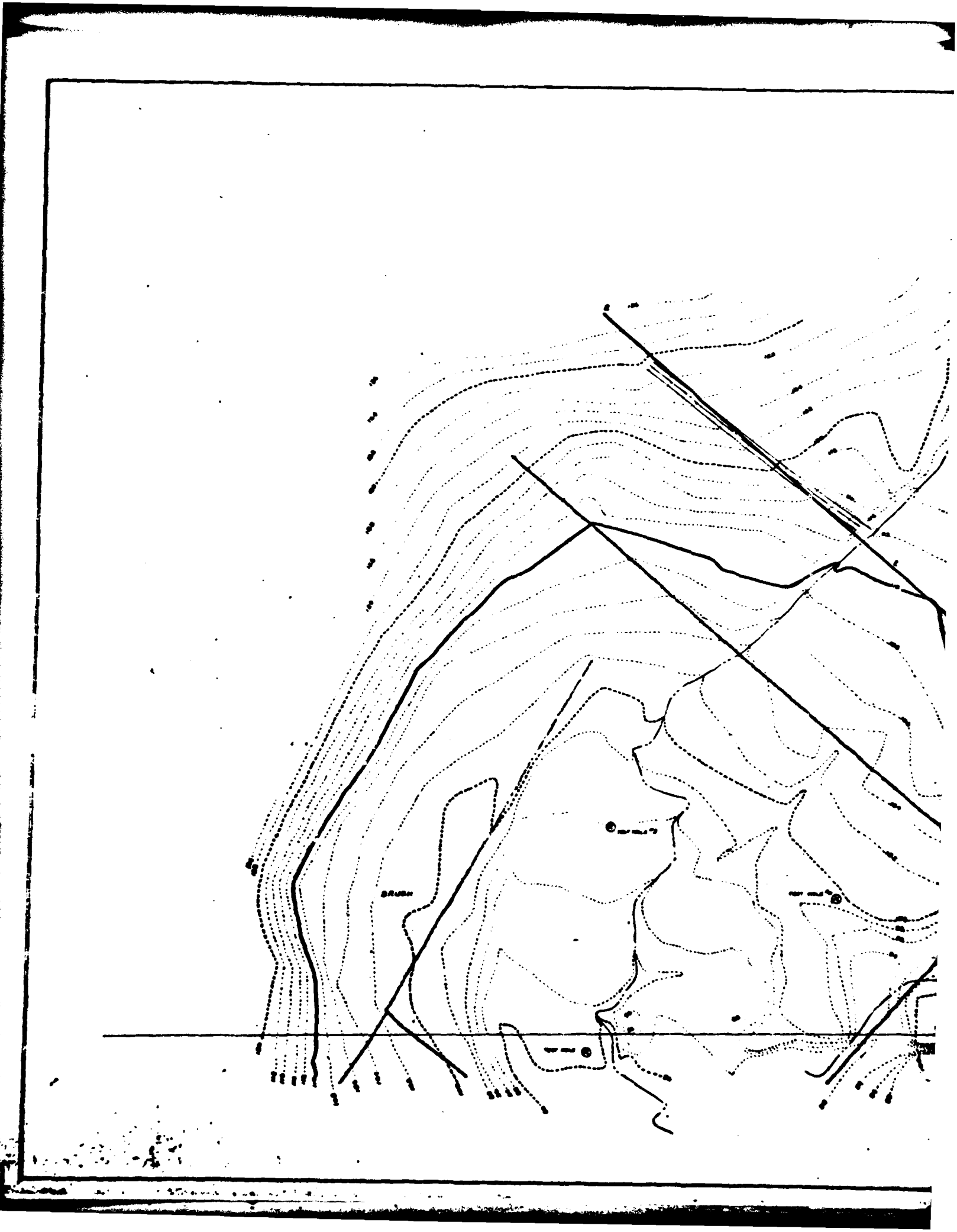
DATE JUNE 1984

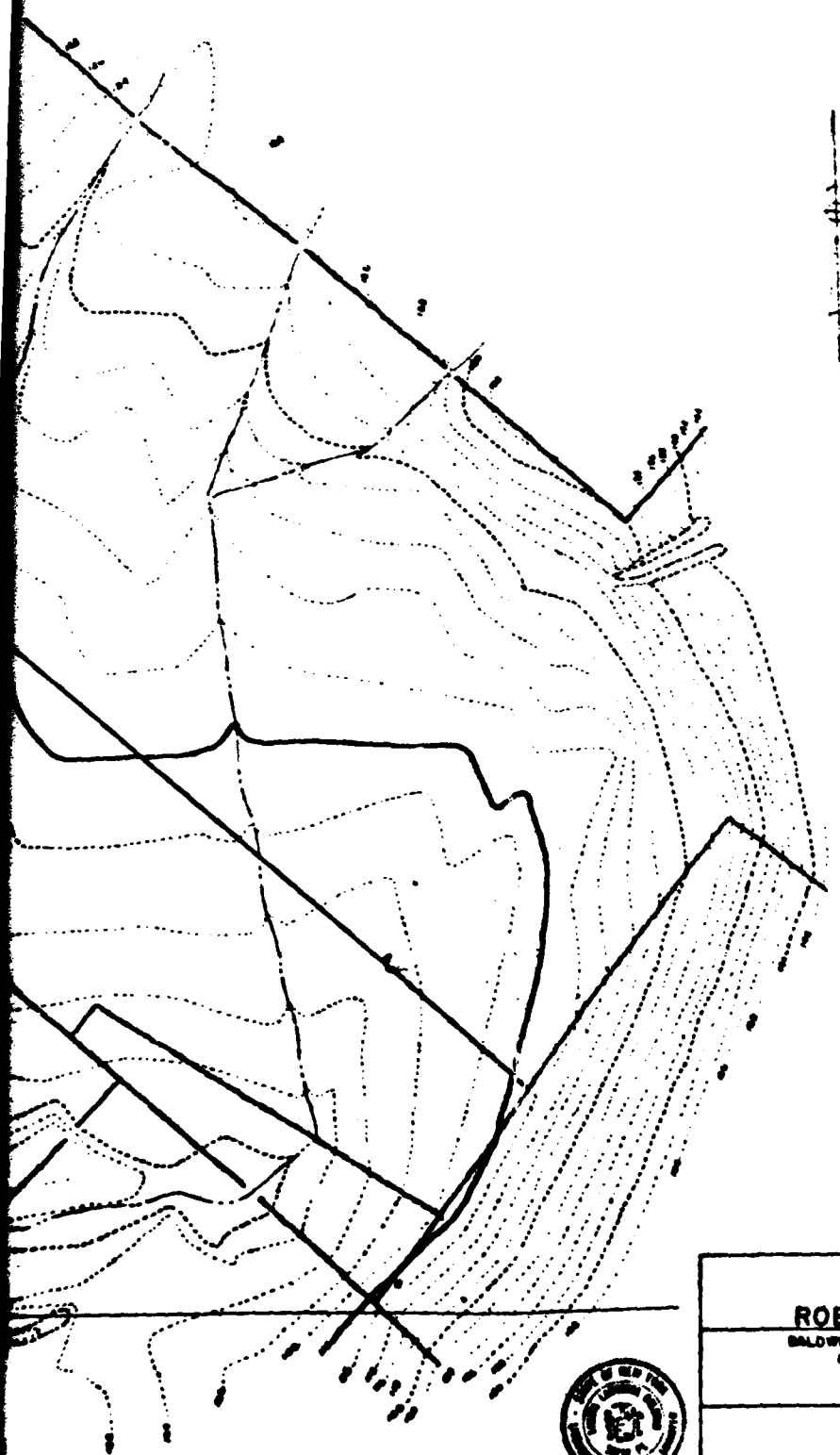
DRAWING NO. 833-2

SCALE 1" = 40'

DRAWN BY C.S.

CHECKED BY E.L.B.





DAM & LAKE
FOR
ROBERT L. BISHOP

BALDWIN - KALIBUS ASSOCIATES
ENGINEER SURVEYOR
466 CHESTNUT ST
CHESCOTA, N.Y. 3529

TOPOGRAPHIC PLAN

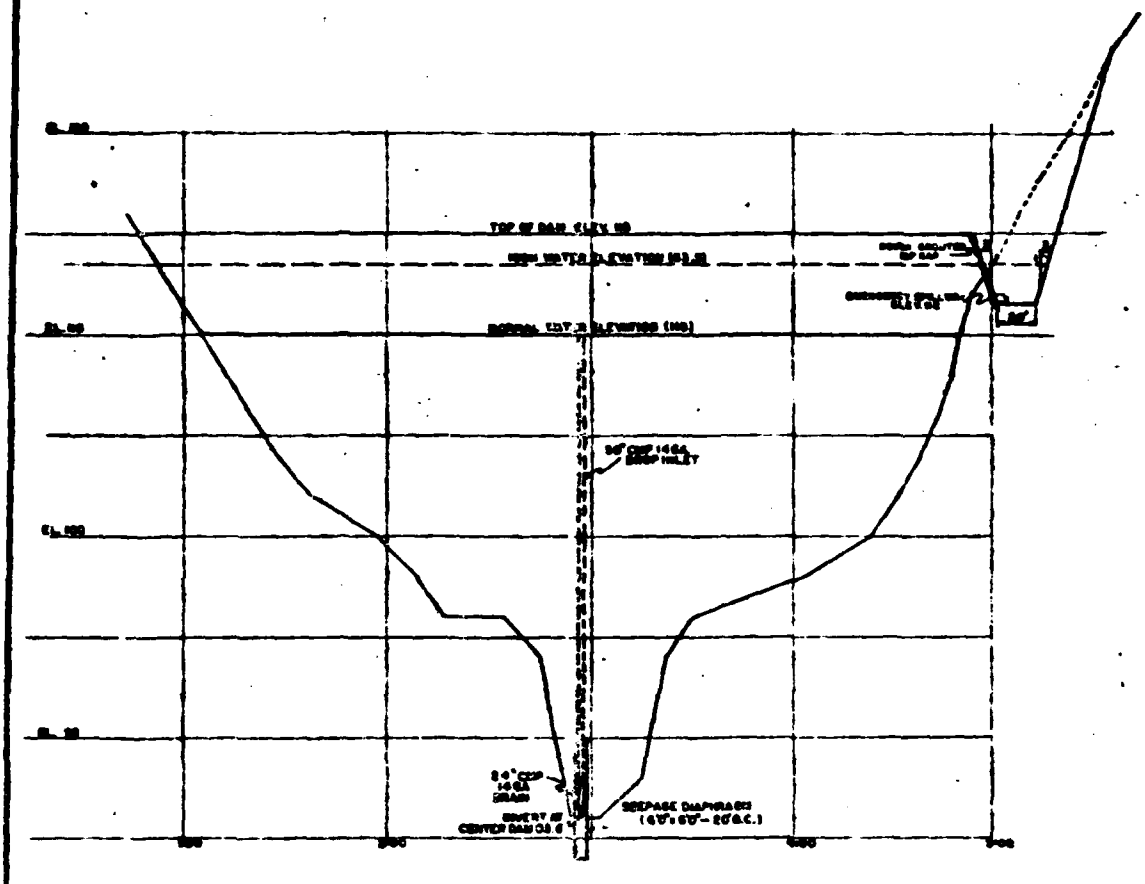
DATE
JUNE 1966

DRAWING NO.
1953-3

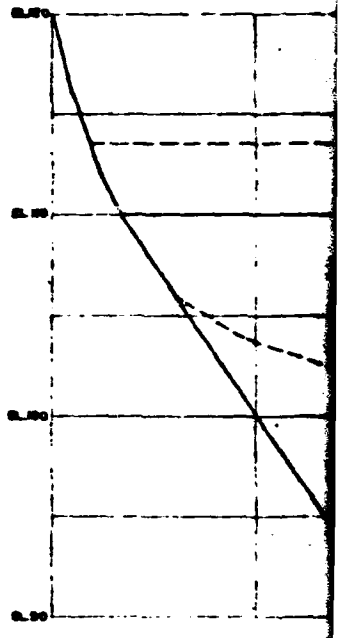
SCALE 1" = 40'

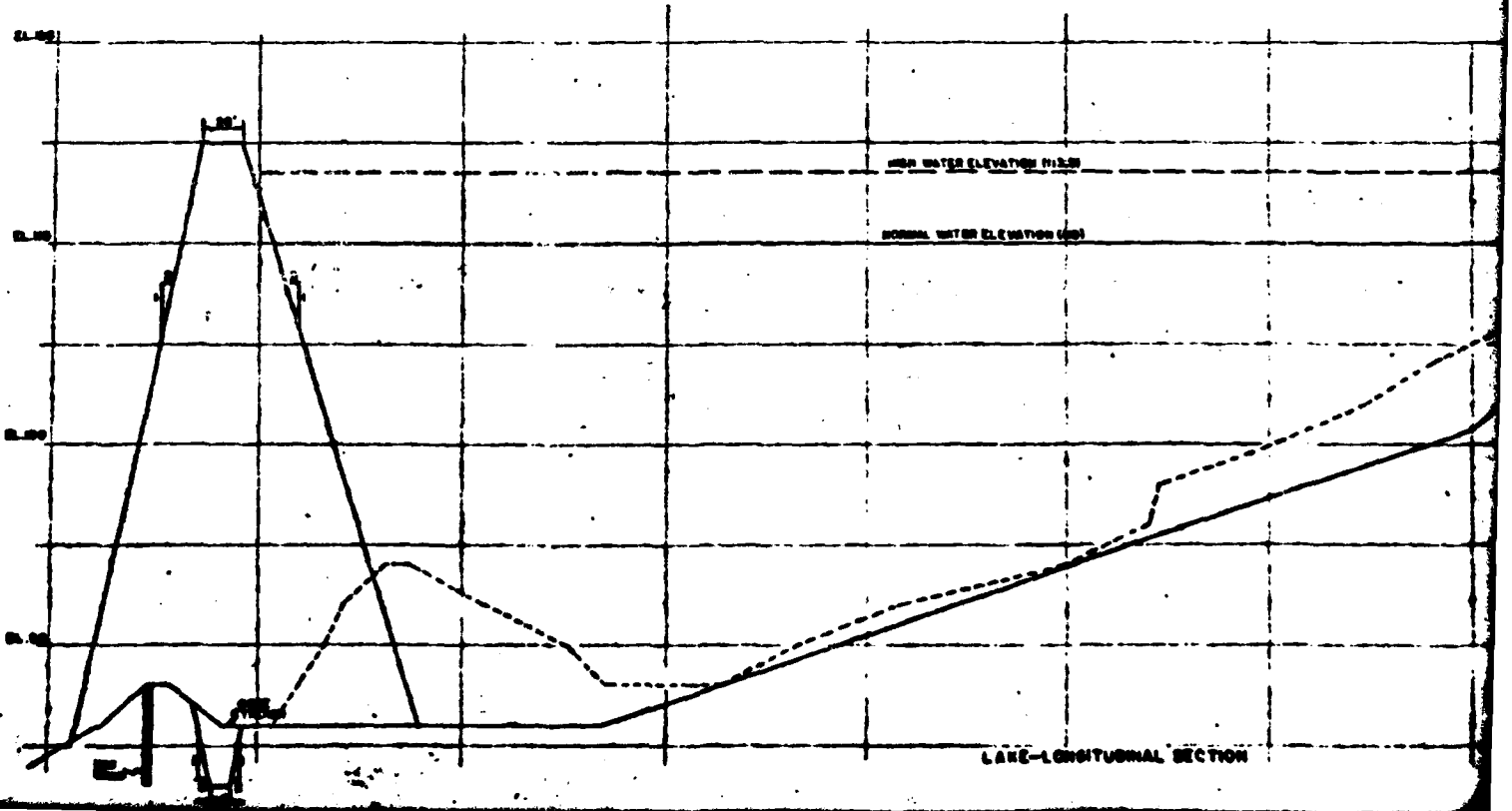
DRAWN BY
E.V.

CHECKED BY
B.L.B.

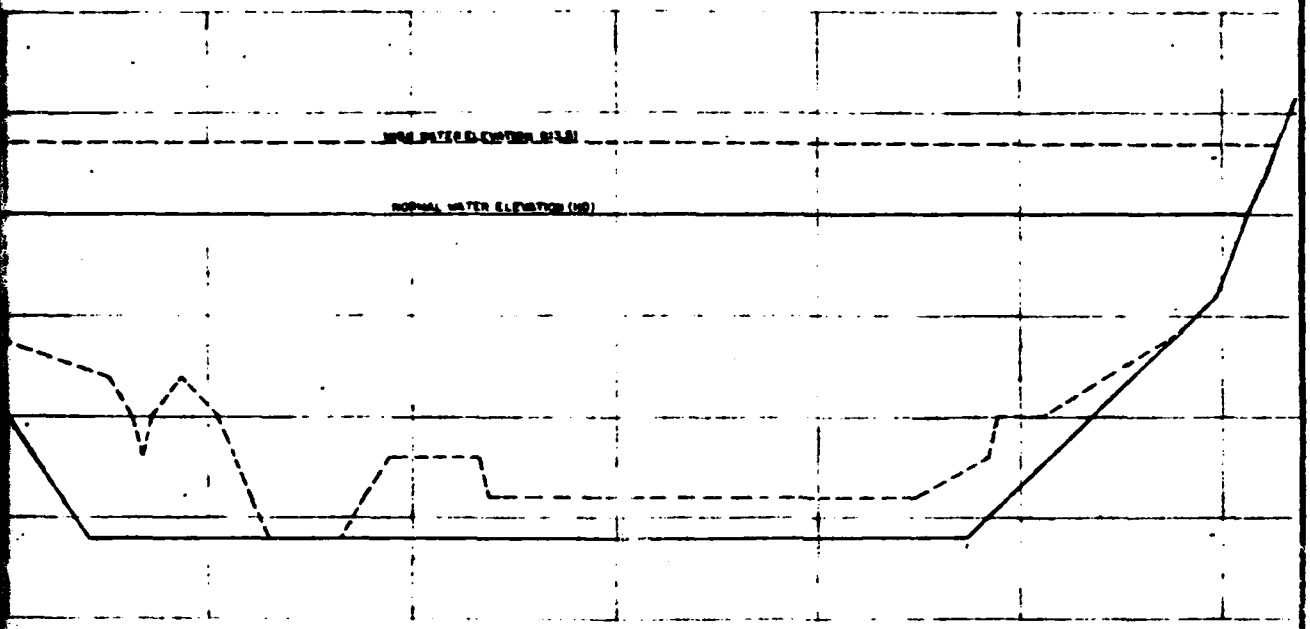


DAM-LONGITUDINAL SECTION

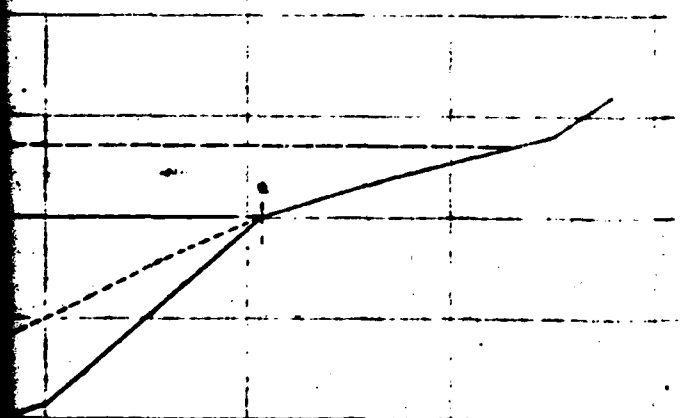




LAKE-LONGITUDINAL SECTION



LAKE-TRANSVERSE SECTION



DAM & LAKE
FOR
ROBERT L. BISHOP

BALDWIN - KALMUS ASSOCIATES
ENGINEER SURVEYOR
40 CHESTNUT ST
ORELONTA, NY 13820

CONSTRUCTION DETAILS

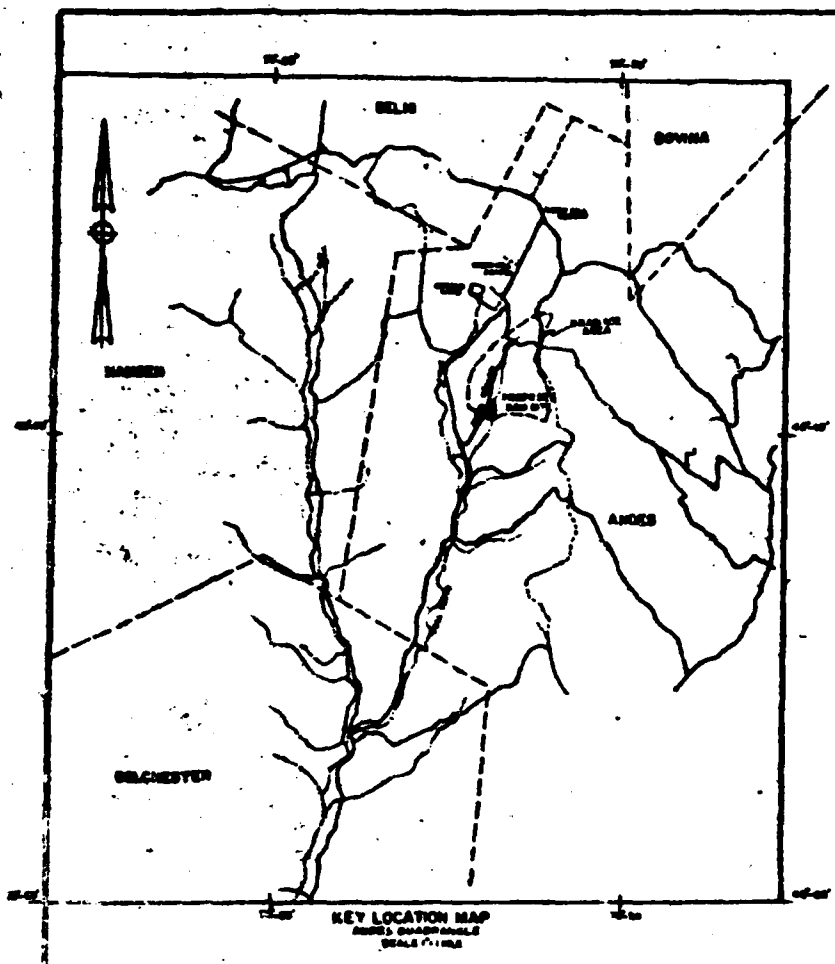
DATE
JUNE 1986

DRAWING NO.
103-4

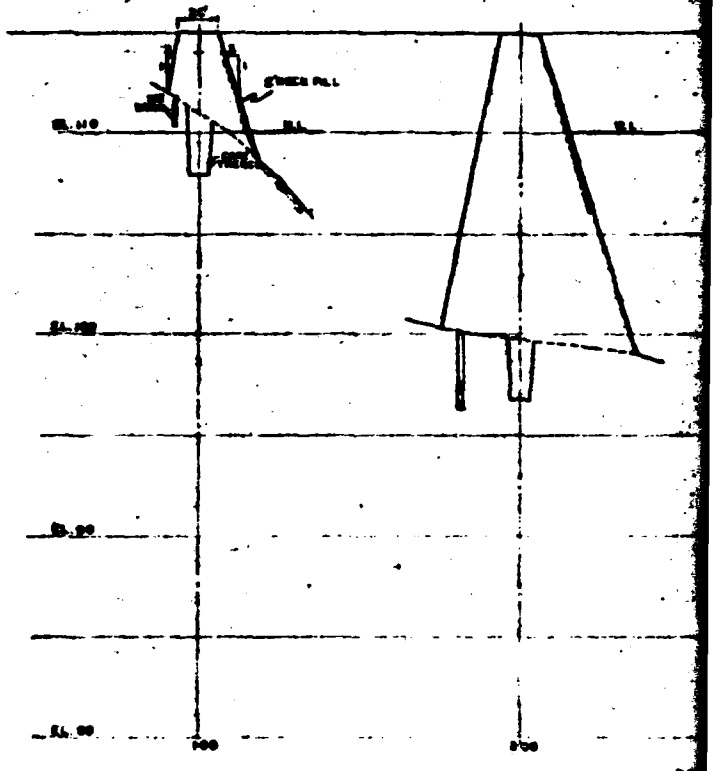
DESIGNED BY
S.K.B.

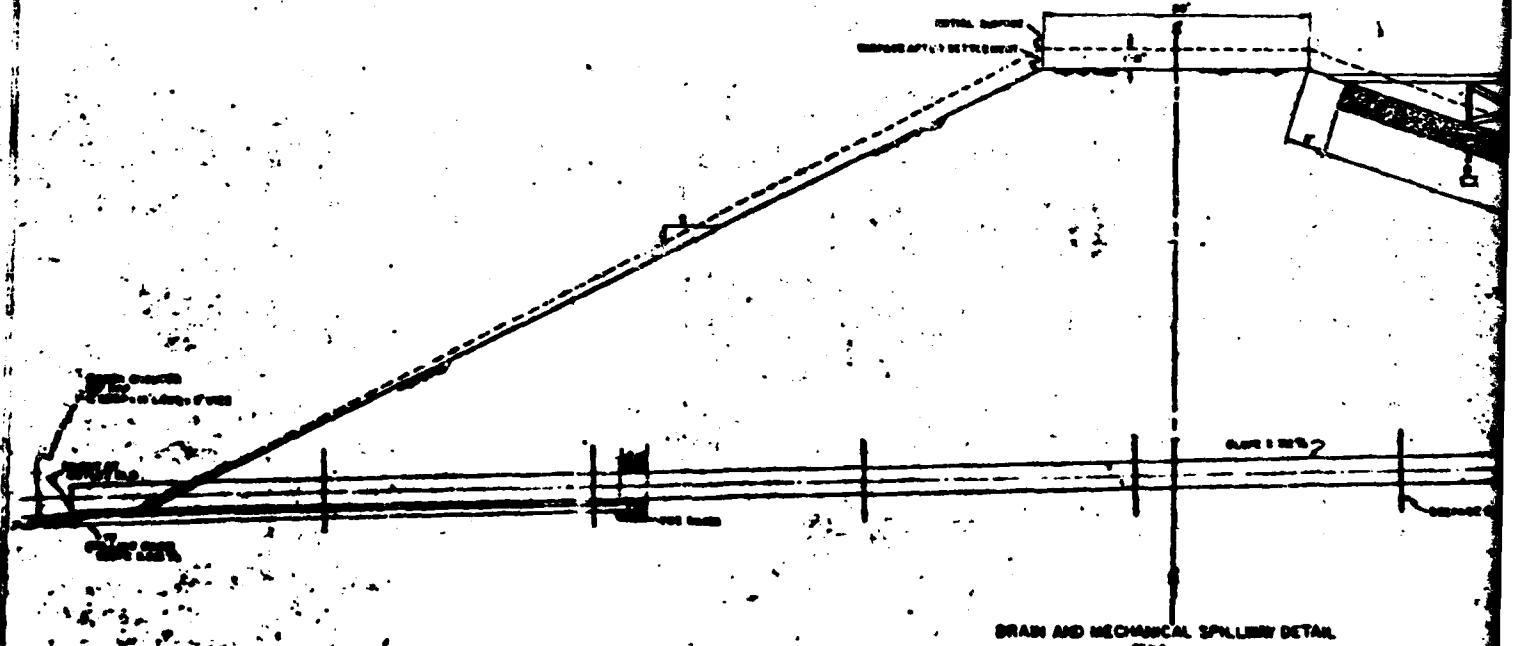
DRAWN BY
B.V.

CHECKED BY

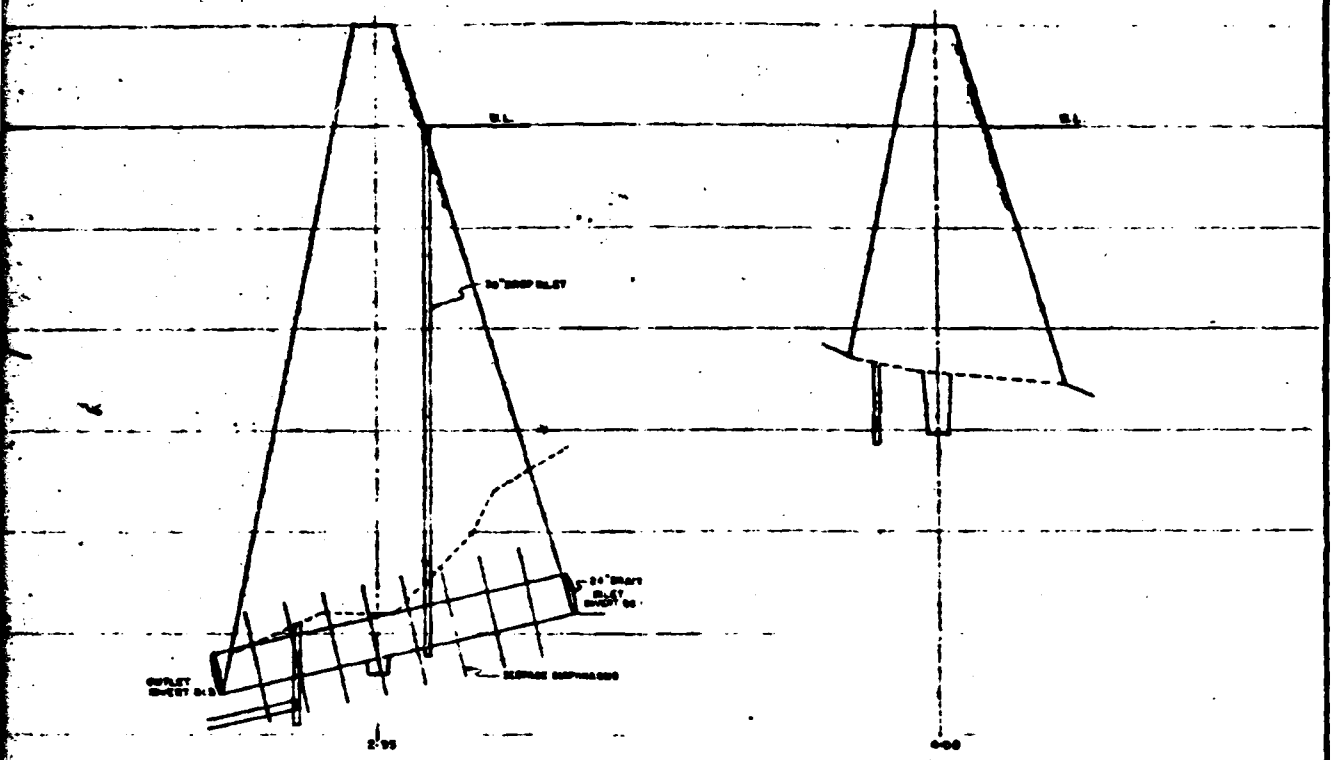


KEY LOCATION MAP

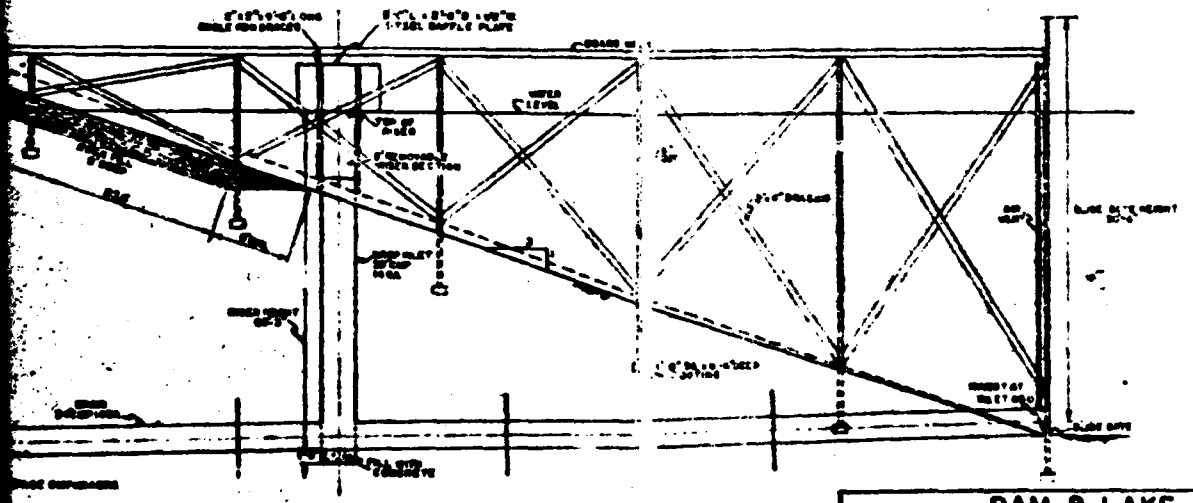




DRAIN AND MECHANICAL SPILLWAY DETAIL



DAM CROSS SECTIONS



DAM & LAKE
FOR
ROBERT L BISHOP

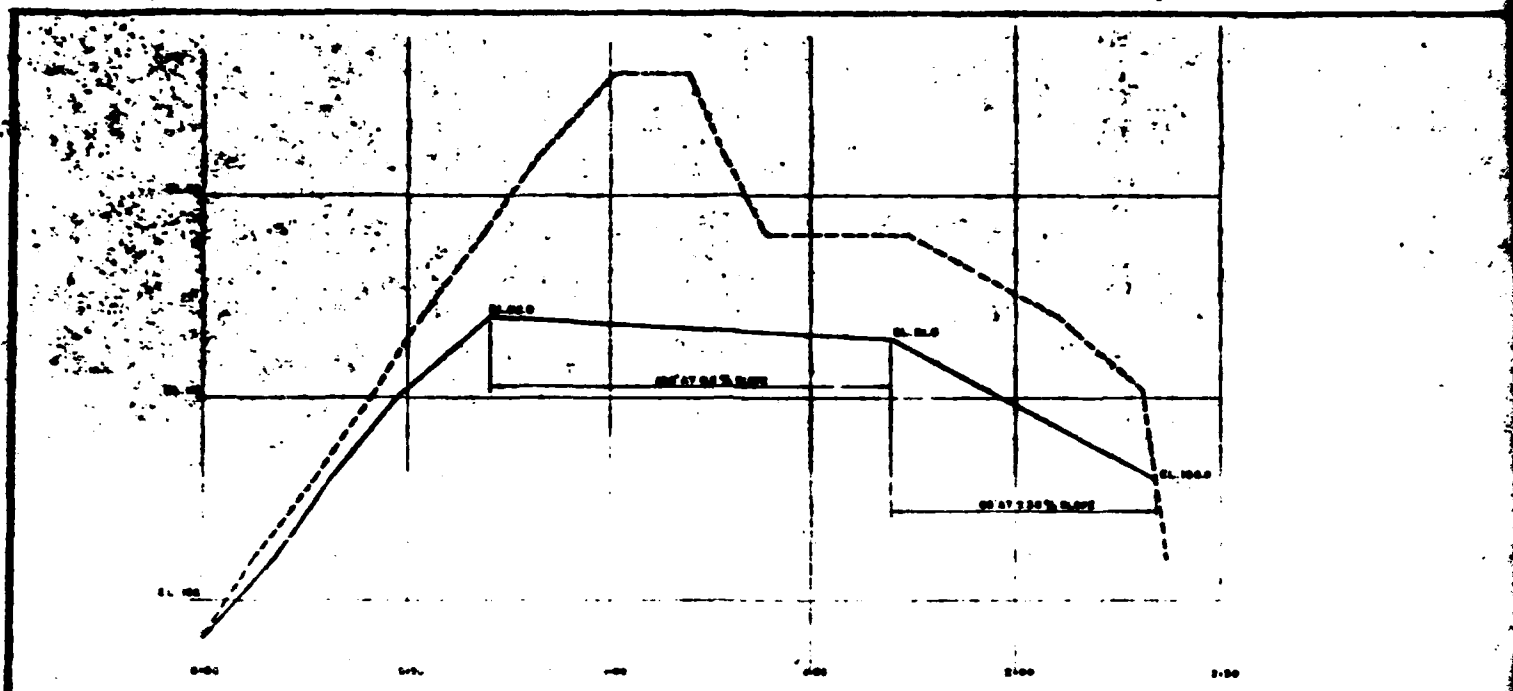
BALDWIN - KALMUS ASSOCIATES
ENGINEERS SURVEYORS
418 CHESTNUT ST
ONEONTA, NY 13820

KEY LOCATION MAP
AND
CONSTRUCTION DETAILS

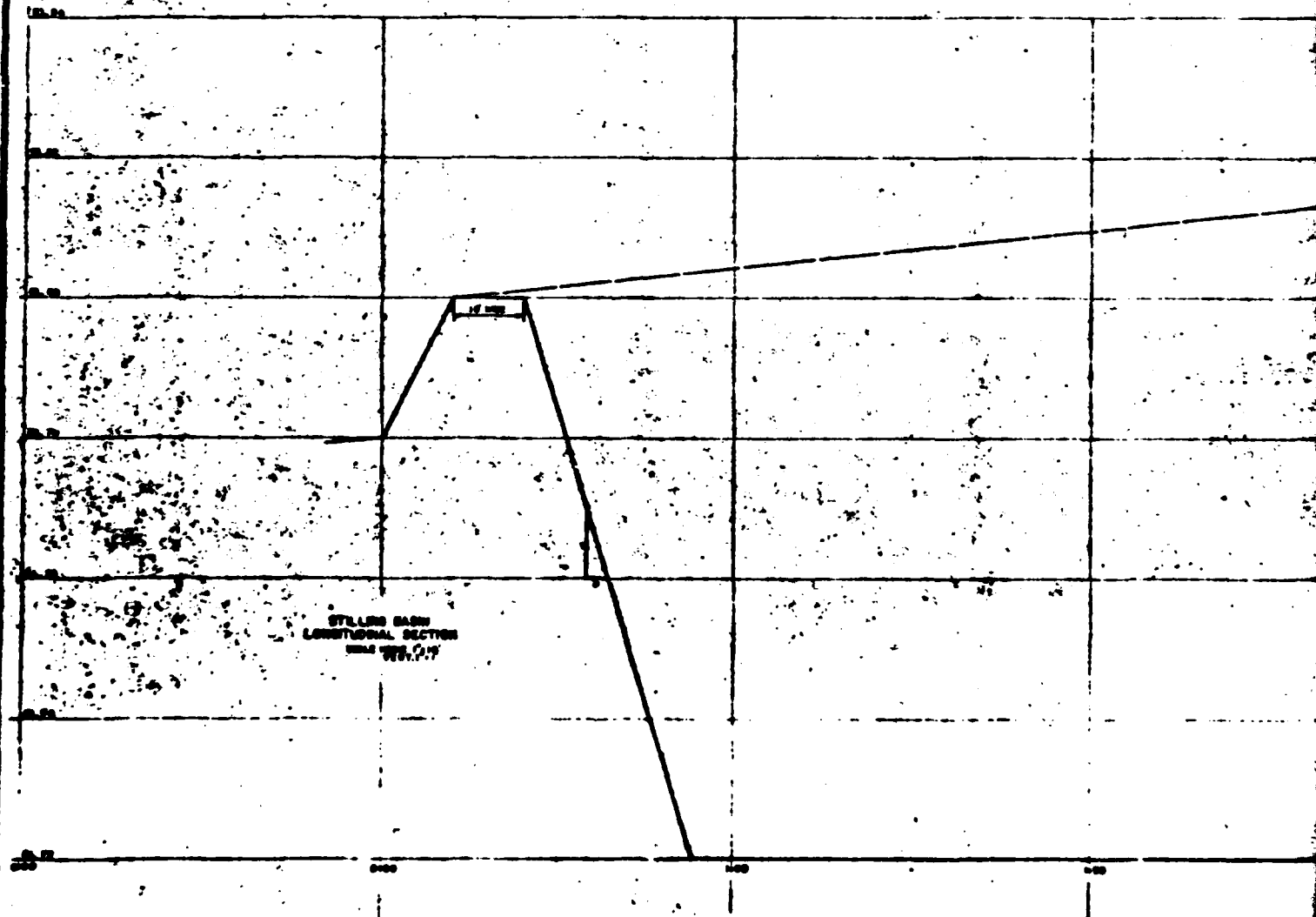
DATE: JUNE 1988

DRAWING NO: 1983-5

SCALE	DRAWN BY	CHECKED BY
AS SHOWN	E.V.	B.K.B.

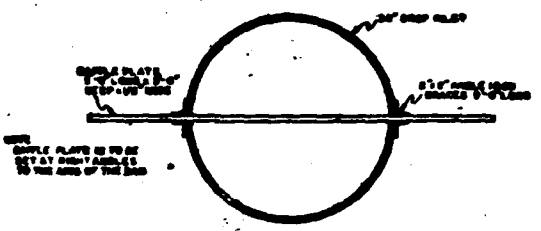


EMERGENCY SPILLWAY - LONGITUDINAL SECTION

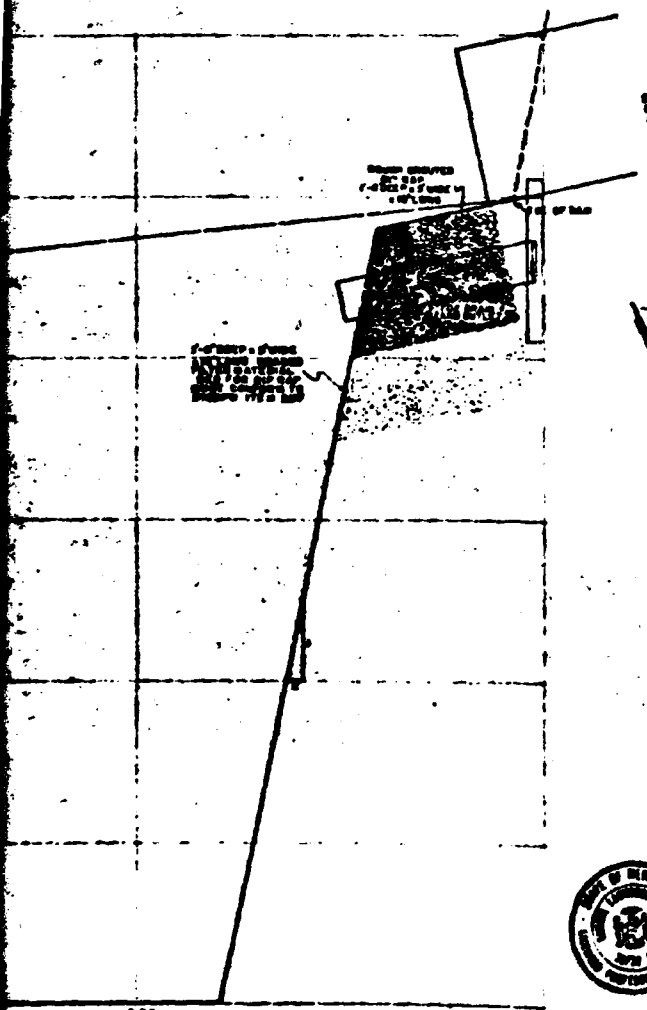


STILLING BASIN
LONGITUDINAL SECTION

CROSS SECTION OF
EMERGENCY SPILLWAY
SCALE 1"=5'



TOP VIEW OF
MECHANICAL SPILLWAY
SCALE 1"=1'



CORE TRENCH DETAIL
SCALE 1"=5'

DAM & LAKE
FOR
ROBERT L. BISHOP

BALDWIN - KALMUS ASSOCIATES
ENGINEERS SURVEYORS
450 CHESTNUT ST
SEBASTOPOL, NY 95472

CONSTRUCTION DETAILS

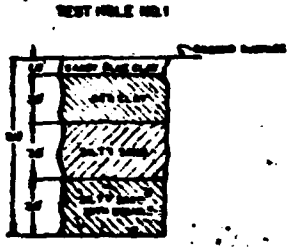
DATE
JUNE 1986

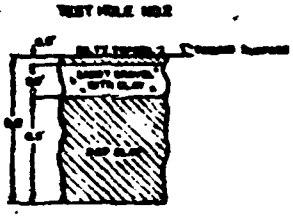
DRAWING NO.
1188-6

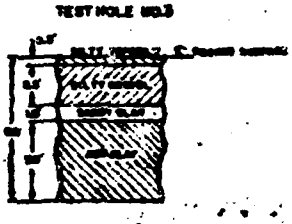
SCALE
AS SHOWN

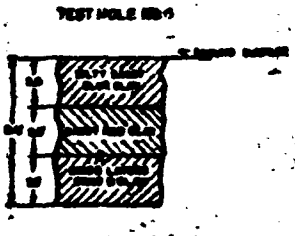
DRAWN BY
E.V.

CHECKED BY
B.L.B.

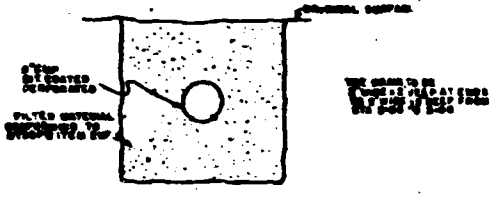




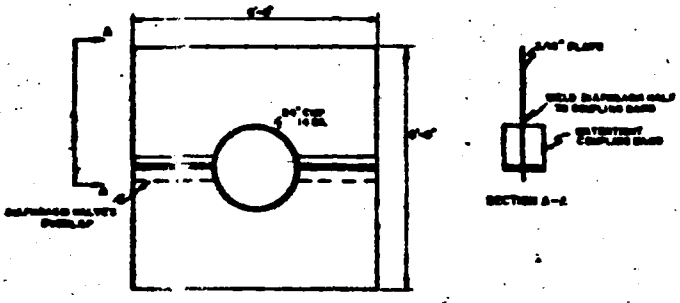




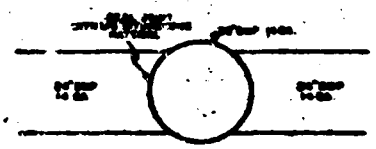
SECTIONS OF TEST HOLES



TOE DRAIN DETAIL



SEE: W.E DIAPHRAGM DETAILS



DROP INLET DETAIL

DAM & LAKE

FOR

ROBERT L. BISHOP

BALDWIN - KALMUS ASSOCIATES

ENGINEERS SURVEYORS

CONSTRUCTION DETAILS

DATE JUNE 1988

SCALE AS SHOWN

DRAWN BY E.K.

CHECKED BY B.A.B.